Soils of Floodplain Meadows – Professor David Gowing

David: I'm in a floodplain meadow just outside Milton Keynes managed by the Parks Trust and in fact we're using this site as part of a cutting experiment, hence the vegetation at different heights. But today we're going to look at what's beneath our feet and explore the soil.

So to understand the soil we need to look at the profile and the easiest way to do that is with something called a gouge auger which is what I have here, sometimes called a Dutch auger. So we're here in mid-September and the soil is pretty dry so it's going to be tough to get started. September-October tends to be the driest period of the year for soils. Here's the topsoil with a little bit of litter, a lot of root and so the auger will continue to take small cores like that out. It's important to bend the knees to lift the auger and pull it out with your legs not your back. So again more dark brown soil absolutely full of roots. Then we can continue to do that right through the profile and over here I have one I've done earlier.

So we're about 85cms down and I've stopped because you might be able to hear I've hit stone at the bottom and that's the gravel layer. I've laid out the profile that I took from this hole from the grass at the top, A horizon, B horizon and at the bottom you can see we have pieces of quite large gravel that has stopped the auger going deeper. So once we have the soil profile, there's a range of characteristics we're interested in. People often talk about the texture of the soil. So if we take a little bit and wet it up and then rub that slurry between our fingers. Then by rubbing that between your fingers, you're able to sense the composition in terms of clay, silt and sand. Clay feels particularly sticky. Silt feels slippery, like soap, and sand feels gritty. So just feeling this sample there's definitely clay in there, it's feeling sticky, but also quite a lot of silt. It's very slippery. So I think we'd class this as a silty clay. So that's the A horizon which is perhaps 35cms deep. Then we move into the B horizon, slightly different colour, mottled orange and grey that we'll come to later. If I now try and texture that, it's really very similar, possibly a little more clay, it's a little stickier, but still plenty of silt as well. No sand. So texture-wise it's still a silty clay, there hasn't been a great change between this A horizon and the B, and then at the bottom we have the gravel. The more important thing from a management perspective in terms of understanding the water regime is the structure of the soil. So here you can see very much a crumb structure. The soil has organised itself into aggregates a few millimetres across and they're very stable in these old meadow soils. They're glued together by organic compounds and this really has effectively the texture of a coarse sand or even a fine gravel in terms of water moving very rapidly through it. So this is the A horizon that's got plenty of organic matter in. Then we move down into a B horizon which does not have such a fine structure. I should say it is difficult to talk about structure too much where you've pulled it out with an auger because the auger tends to collapse the structure and the B horizon, there's probably still some good macropores and fissures that allow water to move, but it's slightly less permeable.

Then down into the gravel that has no structure as such, but again, a lot of porosity, a lot of permeability for water.

So another difference between the A horizon and the B is the colour. The A horizon tends to be a warm brown orangey brown colour, whilst when we get into the B horizon, if we break some of these units open, we can see a mottled effect of quite a bright orangey brown and a bluey grey colour. These colours are reflecting the oxidation state of the iron in the soil where orange is the oxidised form, the ferric salts, and the grey is the reduced form, the ferrous salts. The reduced salts form by bacterial action when the soil is saturated and there's no oxygen available, whilst the ferric salts develop when oxygen returns to the soil. So where you get this mottling with both colours it indicates that the water table is moving up and down this profile and you're getting periods of anoxia without oxygen, and then periods where the soil is aerobic. So we can, just by looking at the colours, say something about where the water table is and for how long. As we go lower in the profile we expect to see more of the grey colour, though here, because the texture is beginning to change now and you can feel the grittiness of the sand, that complicates the colour story. So the gravel is sitting in a matrix of sand which is very permeable.

So in terms of actually quantifying the water regime we can use a hole like this one we've just made to install a dip well. A dip well is simply a piece of wastewater pipe that's drilled at regular intervals and that will slot into a hole to keep it open. Typically in a meadow we would saw it off at ground level and put a plate on it to protect it from vehicles and stock. Then using a graduated staff like this we could regularly revisit and measure the position of the water table. We call this a buzzing stick because when it's in this case hitting the bottom of the hole you get a beep. It does the same when you hit water. But this profile at the moment is entirely dry. So a dip well is as simple as that. It costs just a couple of pounds to cut and drill a piece of pipe and then that will stay in for years if needed.

So another thing we can look at with this profile is the rooting depth. The A horizon is absolutely full of roots but as we look down we're getting to sort of 60-70cms and there are still distinct roots in the soil showing the depth of grassland rooting. The roots will reach right down to the gravel layer which is how the plants take up the water but they also are pushing carbon down from their tops into the soil as root exudate. That carbon accumulates through the profile so the darker brown colour near the surface is where most carbon sits but it's a feature of these alluvial soils that they have carbon throughout the profile and so the total amount stored can be very considerable. Another feature of the soils, as I've said, is the extremely good structure which means they can be as much as 50% pore space. So these aggregates have pores between them and that can represent more than half the volume of the soil which makes them conductive to water and able to store a lot of water, but that porosity can easily be lost by compaction. At this time of year the soil is so dry that you can't really compact it, it's really quite strong. But this site is grazed later in the year which is fine. The cattle won't do any harm to the porosity either until

the profile is wet up. Perhaps by Christmas or New Year it will become soft and it's at that point it's important to remove the stock to protect the soil.

So before we go it's important, if we weren't using this as a dip well, to refill your auger hole and to return the soil in the order it came out.

So that is a first look at the soil here using the auger and if necessary the dip well to get a feel for what's beneath our feet. There's a lot more that can be done. So samples can be taken to look at the fertility of the soil, exactly how much carbon it holds, as I mentioned, the porosity of the soil. A lot of additional work could be done depending on what the management challenges are. But the important things we've seen today is this field has a very well developed A horizon, very well structured, suggesting it's never been ploughed and it's been well managed in terms of no vehicles or heavy stock on while it's wet. We didn't see any signs of compaction. We also saw that there was a clear gravel and sand layer at the base and that's very important for the hydrology. The water will be moving off the valley sides towards a stream in the middle of the field there that acts as a drain. So it's a permeable soil over a gravel aquifer, so perfect conditions hydrologically for a species-rich floodplain meadow.