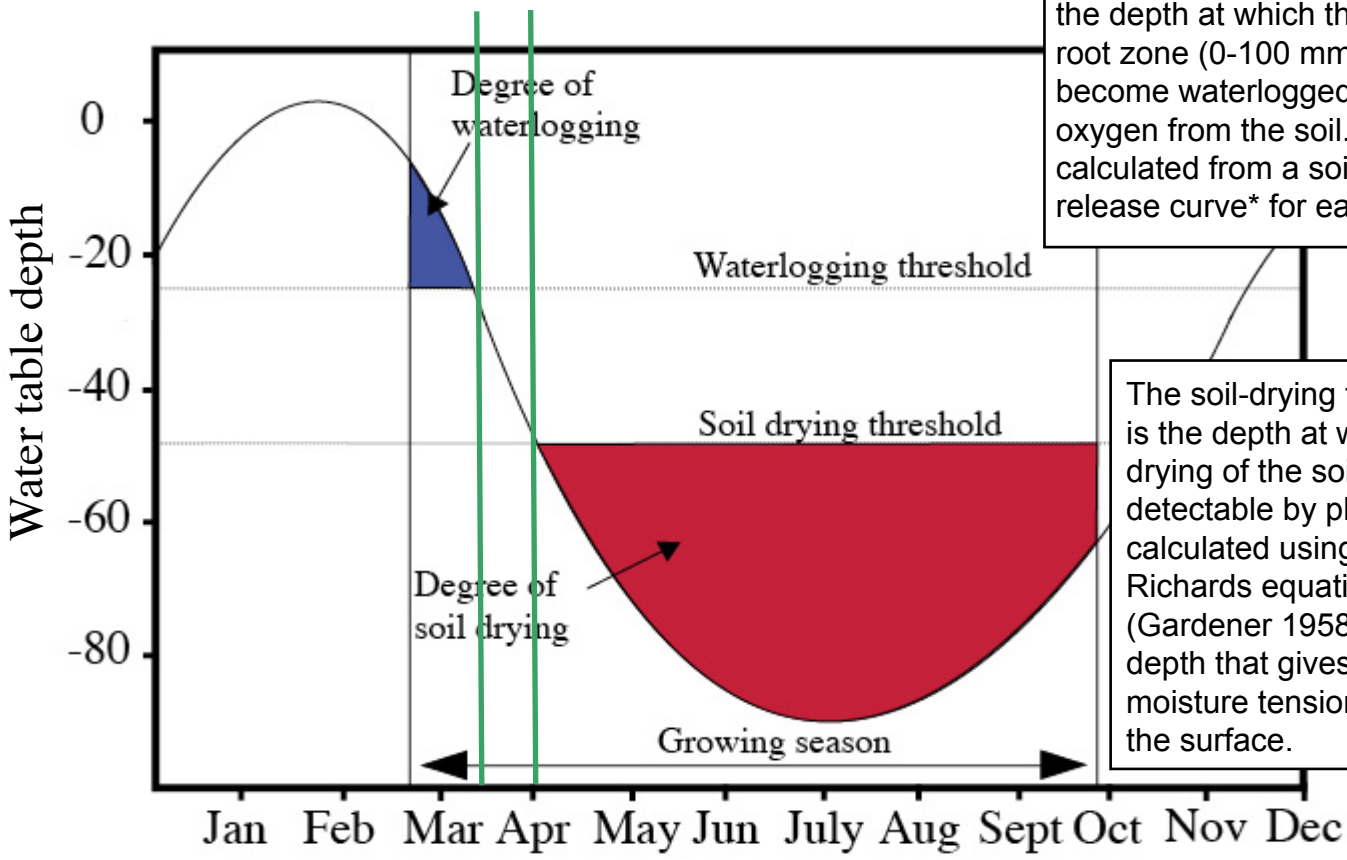
‘THE SPLODGE PLOTS’: what are they, how are they derived and what relevance are they to me?

Much of our understanding of how different plant species (and plant communities) respond to hydrological regimes comes from two DEFRA funded research projects. These projects enabled a number of floodplain meadow sites to be studied in great detail. Botanical data were collected, soil nutrient availability measured and sites undergoing hydrological alteration were monitored to assess changes in plant community composition. The results form the core of the dataset held by the Floodplain Meadows Partnership and if you can get to grips with its interpretation, it will help you understand hydrological changes on your site.

Hydrological models were used to simulate water table behaviour at 3750 separate locations across 18 different sites, each of which had been recorded in terms of its plant community composition. Water-table depths were measured fortnightly on the ground such that field-scale hydrological models could be validated, and then these models were used to estimate the water-table depths at all 3750 locations each week for the ten years preceding the survey date . A massive amount of hydrological data was thereby amassed. In order to understand what it all meant in relation to plant communities, Sum Exceedence Values (SEV) were calculated.

The graph below represents a typical hydrograph for a floodplain meadow, showing how the water-table changes throughout the year. It is overlain with two pre-defined threshold depths (one for waterlogging and one for soil drying). The values of the threshold depths vary from site to site depending on soil porosity.



The waterlogging threshold is the depth at which the main root zone (0-100 mm) begins to become waterlogged, excluding oxygen from the soil. Its value is calculated from a soil moisture release curve* for each site

The soil-drying threshold is the depth at which the drying of the soil becomes detectable by plants and is calculated using the Richards equation (Gardener 1958), as the depth that gives a moisture tension of 5 kPa at the surface.

So during March in this example , the site demonstrates water-logging. The SEV is calculated from the area shaded blue.

During April, the soil is neither waterlogged or dry

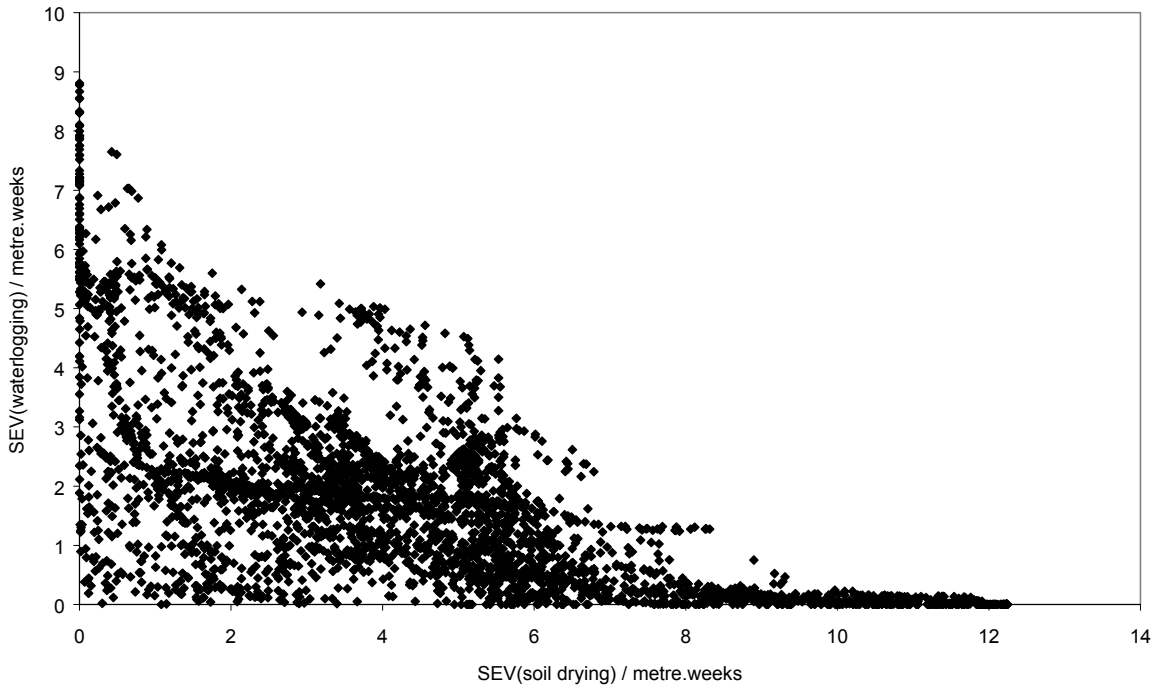
From beginning May to Sept, the soil is detectably dry. The SEV in this case is calculated from the area shaded red.

*A soil moisture release curve can be plotted by taking soil cores from the site, saturating them, then gradually draining then on a sand table in a lab.

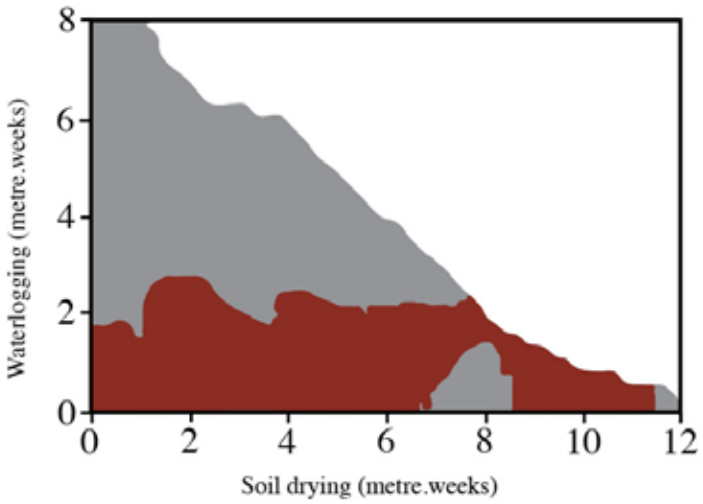
For each of the 3750 recorded locations, an SEV soil drying and SEV soil waterlogging was calculated. A graph showing all 3750 SEV calculations recorded during the study is shown below and demonstrates the spread of hydrological regimes on floodplain meadows in the UK.

The bottom right shows soils that are well drained and dry for much of the year, whilst in the top left are soils that are almost permanently waterlogged. Bottom left are those sites that have stable shallow water tables. In the centre are regimes that fluctuate during the year. No water regimes that would fall in the top right corner have been encountered in our surveys (because such soils would not be suitable for species-rich grasslands.)

For each of the points on the graph, botanical data are available and plots can be drawn by filtering out just the points where a particular plant species has been recorded in order to determine the preferred hydrological regime for that species.



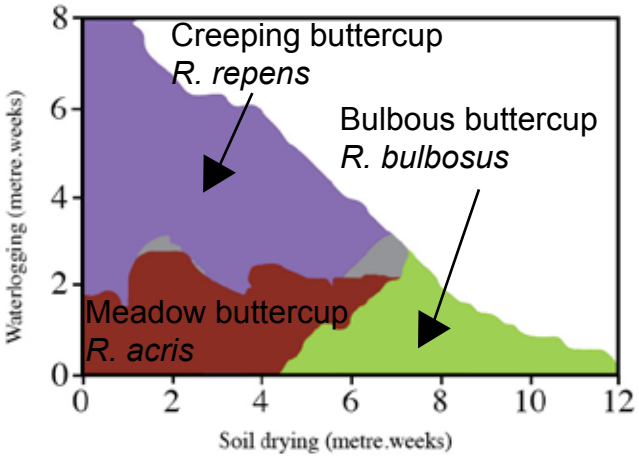
Meadow buttercup *Ranunculus acris* Splodge Plot



The graph adjacent shows the 'splodge plot' for meadow buttercup *Ranunculus acris*. The area shaded brown shows the range of hydrological regimes in which this species is more likely to be found than you would expect by chance. Ecologists would call this range its hydrological niche.

In this case, you can see the species tolerates a broad range of soil drying, but does not tend to be found in waterlogged areas.

Splodge plots for three species of buttercup



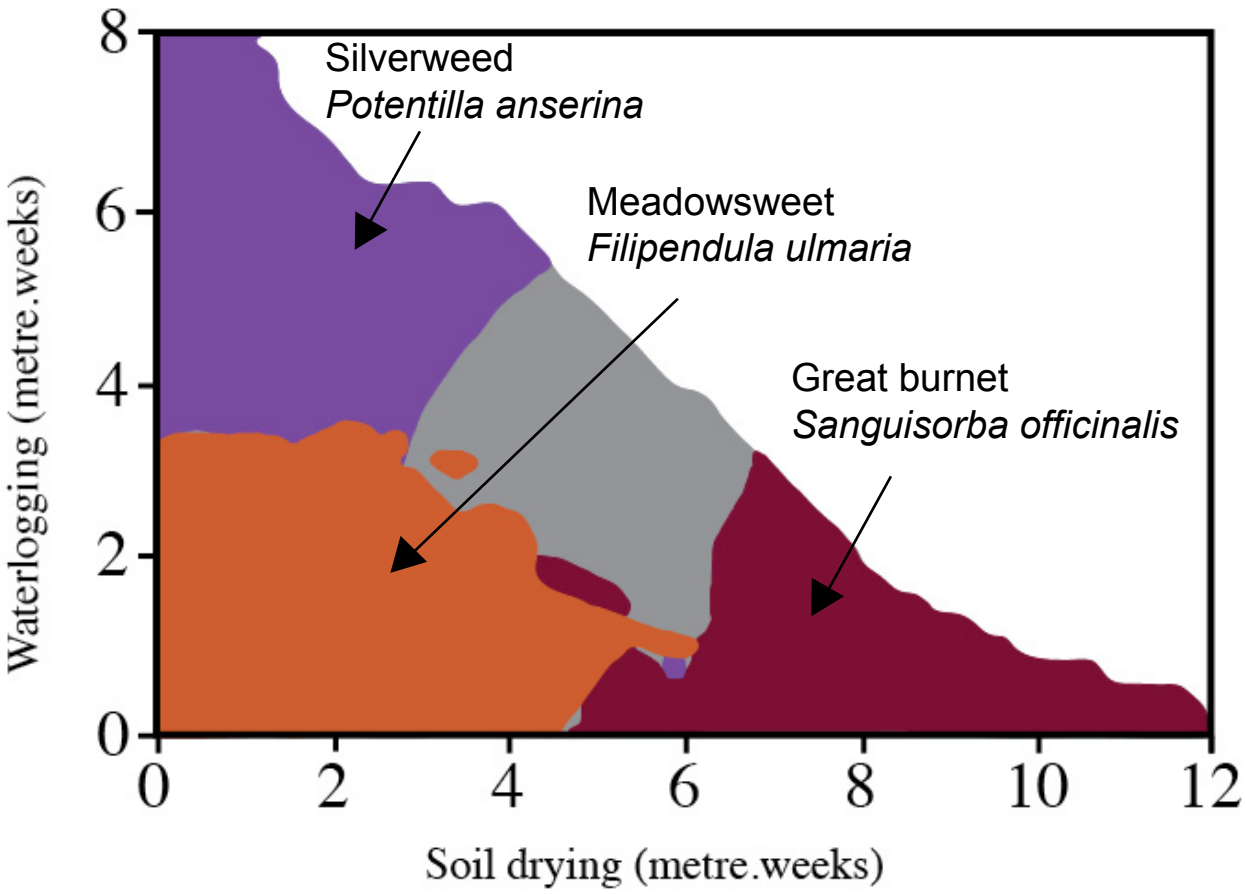
Comparison of the three ranges shows us that each occupies a different hydrological niche.

Bulbous buttercup, *Ranunculus bulbosus* (green), prefers drier conditions and is rarely found on waterlogged soils (top left) or those kept constantly moist (bottom left). Whereas creeping buttercup, *R. repens* (purple), prefers waterlogged soils and is largely absent from those which are dry for much of the year. *Ranunculus acris* occupies a more general position between the two.

An understanding of the range of 'splodge' plots produced will enable you to understand what is happening to your site hydrologically, by knowing the favoured hydrological regimes of the different plant species.

Some of the Rose family

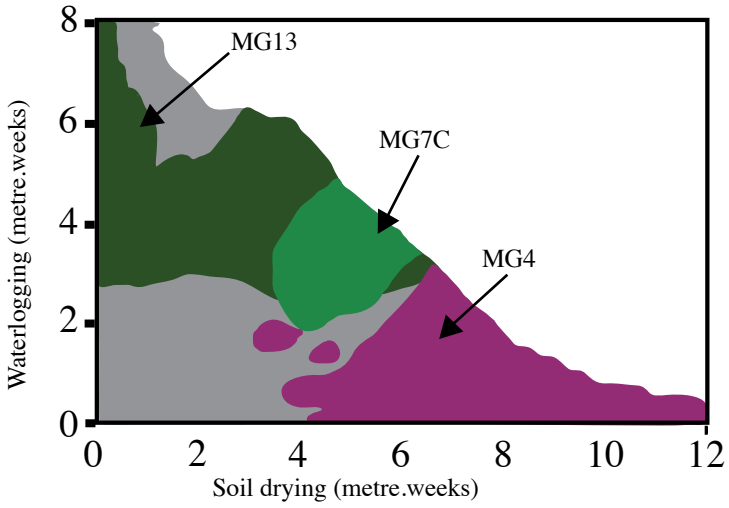
The graph below shows some representatives of the rose family (*Rosaceae*) found on floodplain meadows. Meadowsweet, *Filipendula ulmaria*, will tolerate wetter conditions than great burnet, *Sanguisorba officinalis*, but silverweed *Potentilla anserina* is far more tolerant of waterlogged

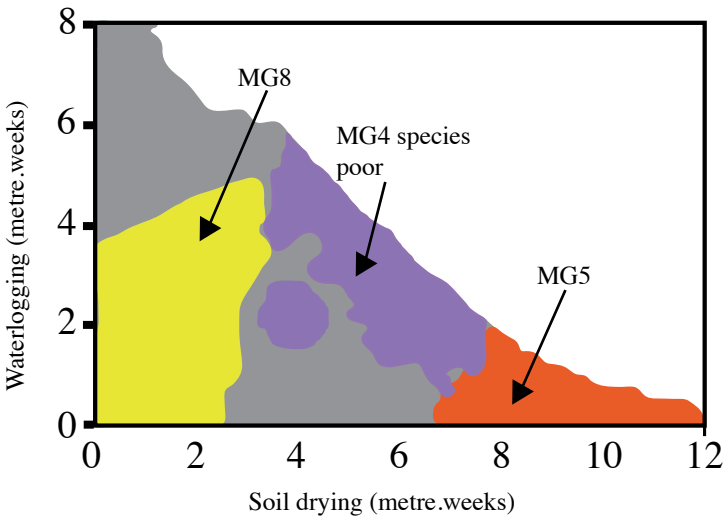


conditions than either of them. It often seems to be the case that closely related species "divide up the available hydrological space between them (probably as a result of divergent evolution).

Splodge plots have been published for a total of 99 different species,so you can see how they compare in terms of tolerance to waterlogging and soil drying. This information is published in the research report available here and forms the basis for the tables in the Floodplain Meadows Partnership FSC guide, which tabulates different species tolerance of hydrological conditions, as well as soil fertility. The FSC guide is available through the FMP, please **contact us for a copy.**

NVC plant community plots





Using the same principles and from the same research project, assessments were made for whole plant communities. These community splodge plots have also been published and enable you to see at a glance where each of the main NVC community types sits within the hydrological space of floodplain meadows.

This method of using SEVs is being used elsewhere (including Spanish mountains and South African heaths).

So, what does this mean for you and your site?

1. If you become familiar with the main plants and their preferred hydrological niches, you should be able to interpret what is happening to your site's hydrology.

2. We are developing a tool that enables you to interpret your soil-water/dipwell data in the context of this research. If you enter your dipwell data into the tool relevant to your soil type (generic values for several different soil types are being estimated), then you can establish whether your soil will support one of the typical plant communities above. This will help you to decide whether it is worth considering a restoration project, and perhaps help to identify the seed source to suit your water regime. It will also enable you to see what your soil water levels are doing on existing sites and therefore pick up why there might be community changes occurring.

3. If you construct a soil-moisture-release curve for your site, you can interpret its hydrology more exactly and therefore get a better picture of your plant community and how it functions.