



Soil structure determining plant community composition

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Outline

- Floodplain grassland diversity
- Quantification of water-regime requirements
 - relevance of structure
- Issues of soil compaction
 - changes to structure
- Management issues

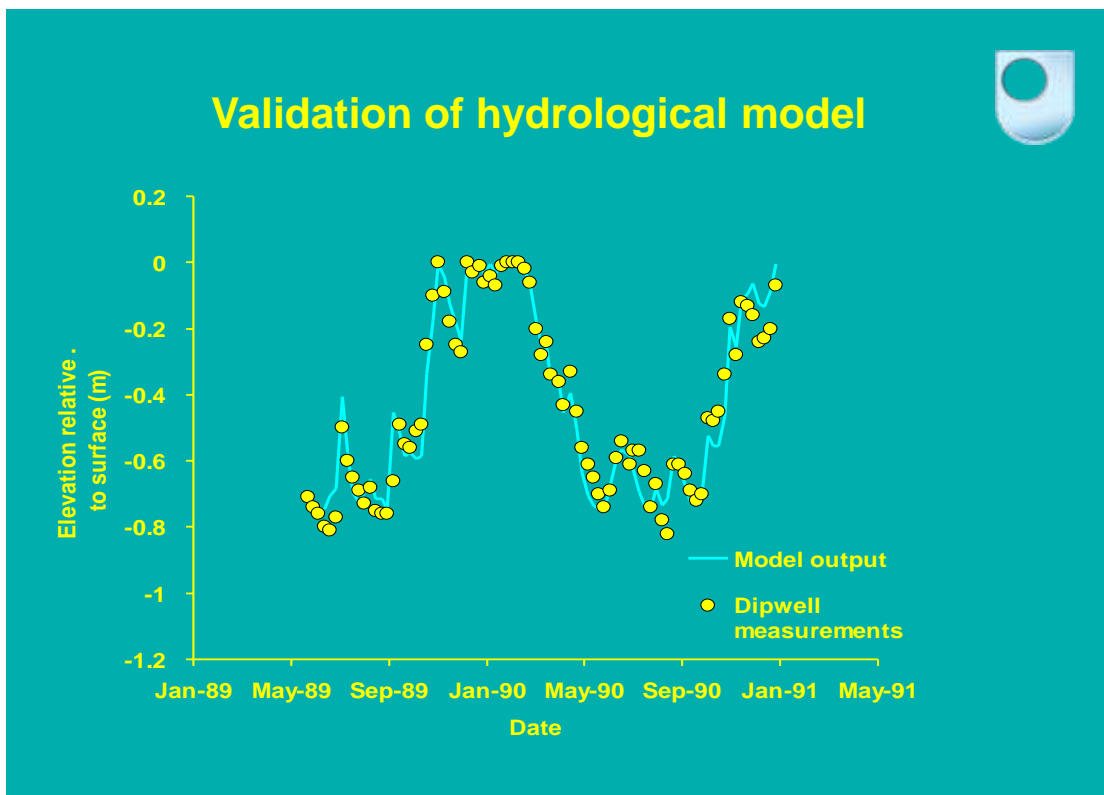


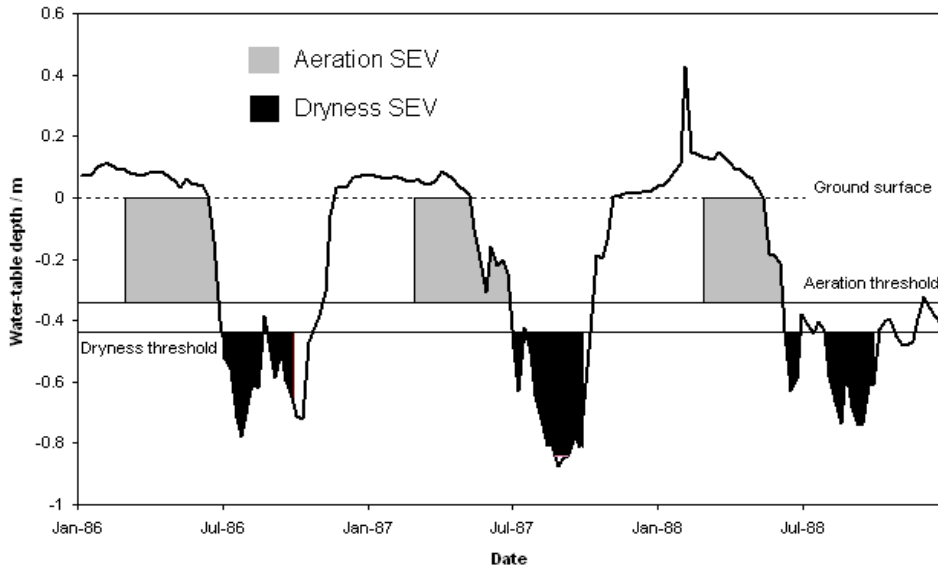
Quantifying water-regime requirements

- Botanical survey of >10,000 positions
- Field-scale soil hydrology models simulate weekly water-table behaviour beneath each position
- Correlation analysis shows annual mean depths are of limited relevance, fluctuation is important



Plant communities segregating along hydrological gradients





**Interpretation of a soil water-table hydrograph
using a peak-over threshold method**



Water-table-depth thresholds

- Soil specific
- Two thresholds:
 - Aeration threshold
 - Air-filled porosity is 10% of soil volume
 - Dryness threshold
 - Plants detect surface drying



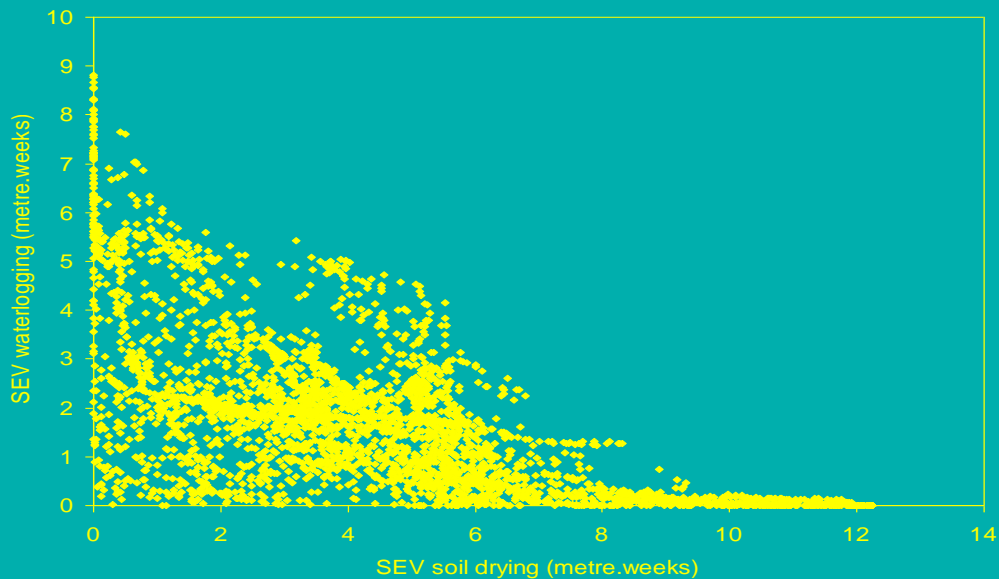
Threshold calculation

$$z = 1/c \ln((1+E/K)/(e^{-cp}+E/K))$$

Where

- z is depth to water table
- c is the unsaturated exponential coefficient
- E is evaporative flux
- K is the saturated hydraulic conductivity
- p is the soil moisture tension at the soil surface

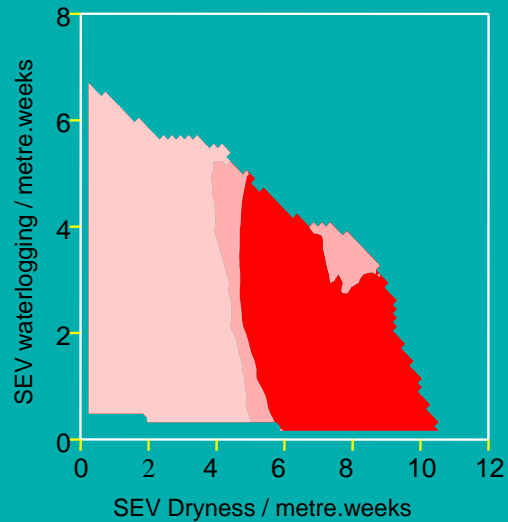
Set of modelled water regimes



Source: Defra project BD1310 Final report 3750 points

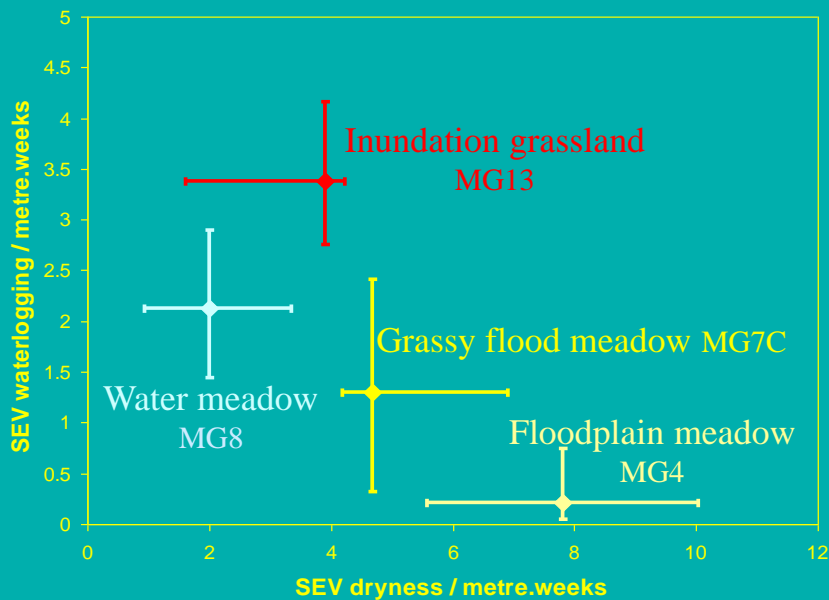
Species SEV tolerances

- Meadow vetchling (*Lathyrus pratensis*) frequency relative to SEVs
- Dark red zone represents high relative frequency
- >3000 sample positions from 7 sites across England

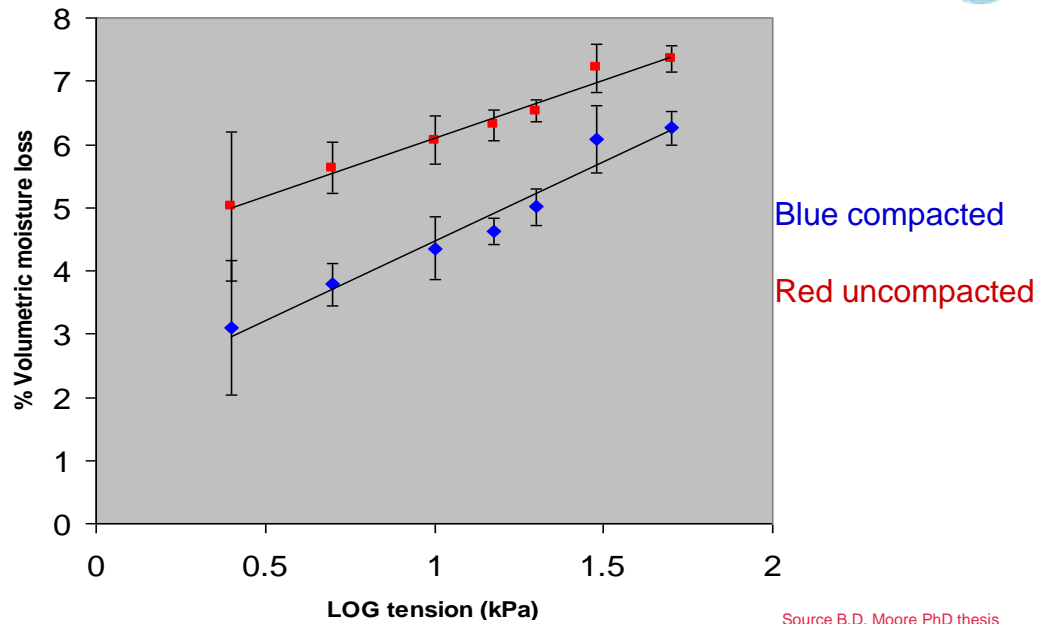


Community tolerance ranges

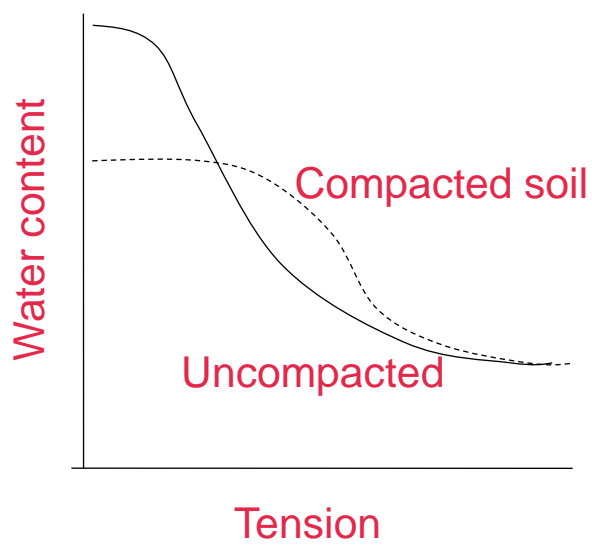
median and inter-quartile range



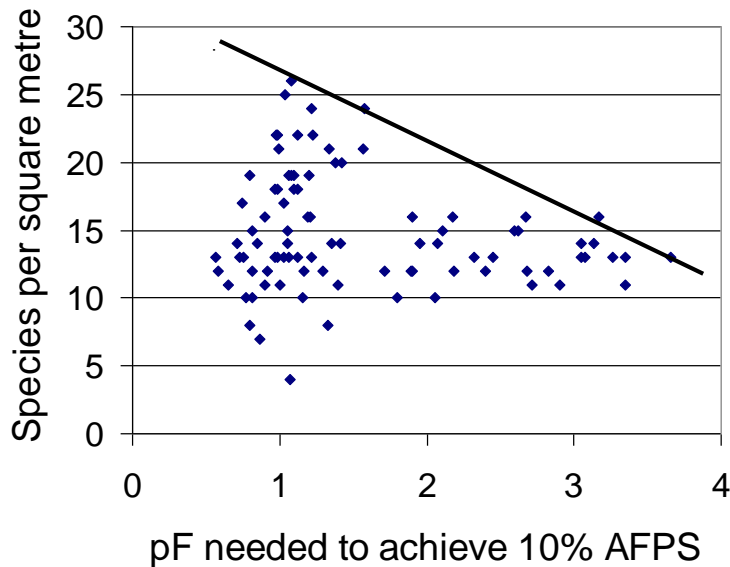
Soil moisture release curve



Effect of compaction



Species richness vs porosity



Source B.D. Moore PhD thesis



Other studies

- Holman and Palmer (2004) across 15 Yorks. meadows
 - correlated Species-richness against multiple variables
 - depth of well-developed structure was the best predictor of species richness
- Gilbert, Lawson et al. (1997) sampling English Meadows
 - demonstrated easily available-water capacity differed significantly between species-rich and species poor meadows



Grassland management

- Hay meadows require mowing in midsummer
 - to sustain diversity
 - management agreements stipulate cutting dates
- In wet summers, alluvial soils lack strength
 - results in rutting and compaction
- Trade off between the pros and cons of mowing



Rutting of previously well-structured meadow soil



Summary

- Meadow vegetation is highly responsive to soil hydrology
- The response is soil-specific and depends on structure
- Highly structured (porous) soils support highest diversity
- Soil structure needs conservation just as the vegetation does
- Management needs to be responsive to soil needs