NORTH WYKE ROTHAMSTED RESEARCH

defra Department for Environment Food and Rural Affairs

ADAS

Phosphorus saturation in riparian buffer strips

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Contents

- Some perspectives on P retention in buffer strips
- Main question: do buffers become ‘full’ of P as they get older?
- Case study: buffer strips in the Demonstration Test Catchments
  - Effects of age
  - Summer vs winter measurements

Key questions relating to buffer strips

- What are they for?
  - Water quality protection?
    - N, P or sediment?
  - Biodiversity?
  - Multifunctionality!!!!
- How efficient?
- How wide?
- Best management?
  - Vegetation type?
  - Cutting regime/harvesting?
  - Landscaping?
- Life expectancy?

What do we mean by degree of phosphorus saturation?

- Degree of phosphorus saturation (DPS) is defined as the ratio of the amount of P sorbed in the soil to the finite capacity of a soil to sorb P

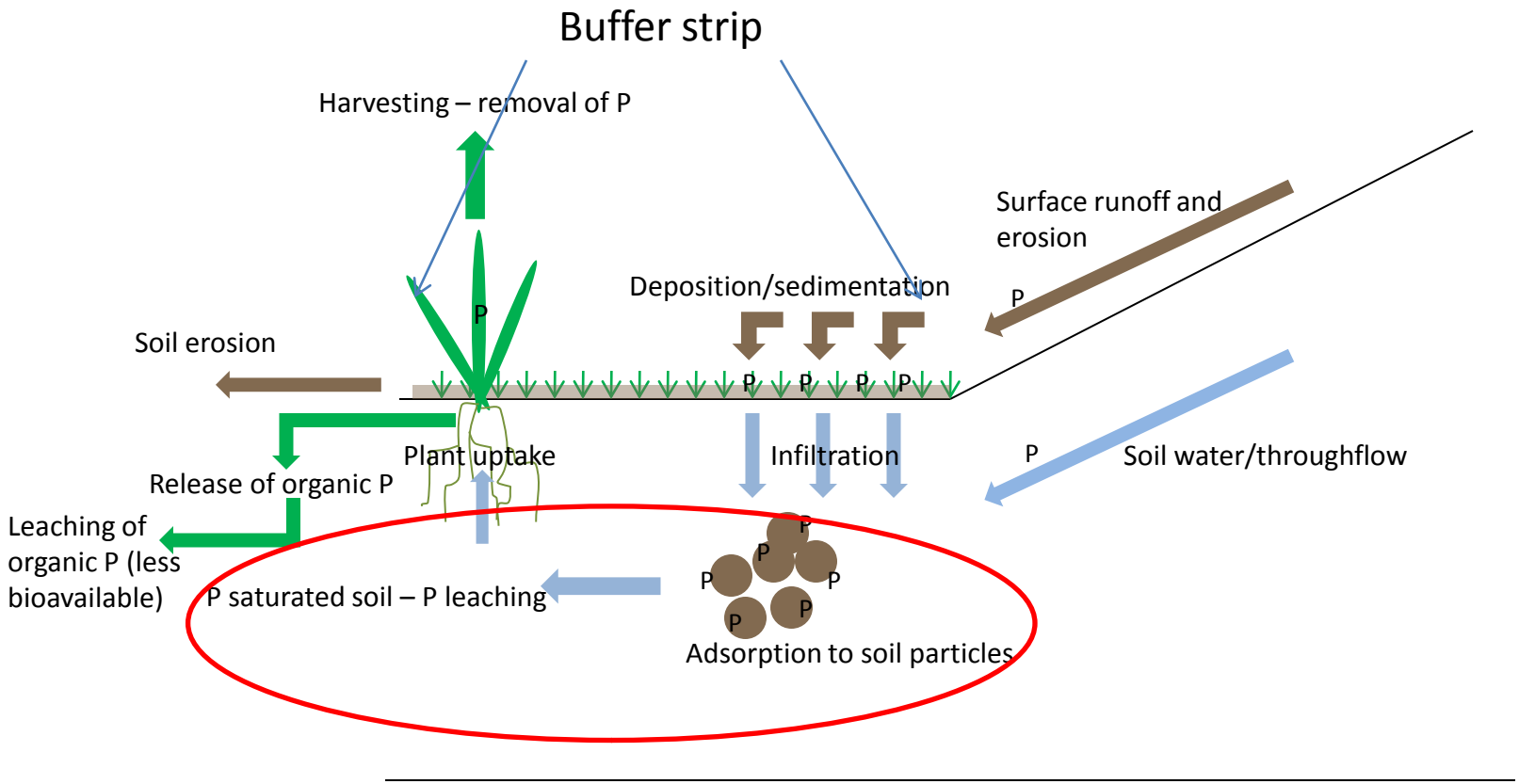
$$DPS\ (\%) = \frac{P\ sorbed}{total\ P\ sorption\ capacity\ (PSC)}\ \text{x}\ 100$$

- Provides an indication of a soil's remaining capacity to bind P
- Requires accurate measurements of 1) P sorbed and 2) total P sorption capacity

  - Oxalate-extractable P (P_{ox}), Fe (Fe_{ox}) and Al (Al_{ox}):

$$DPS\ (\%) = \frac{P_{ox}}{\propto (Fe_{ox} + Al_{ox})}\ \text{x}\ 100$$

Sustainable Buffers for Phosphorus



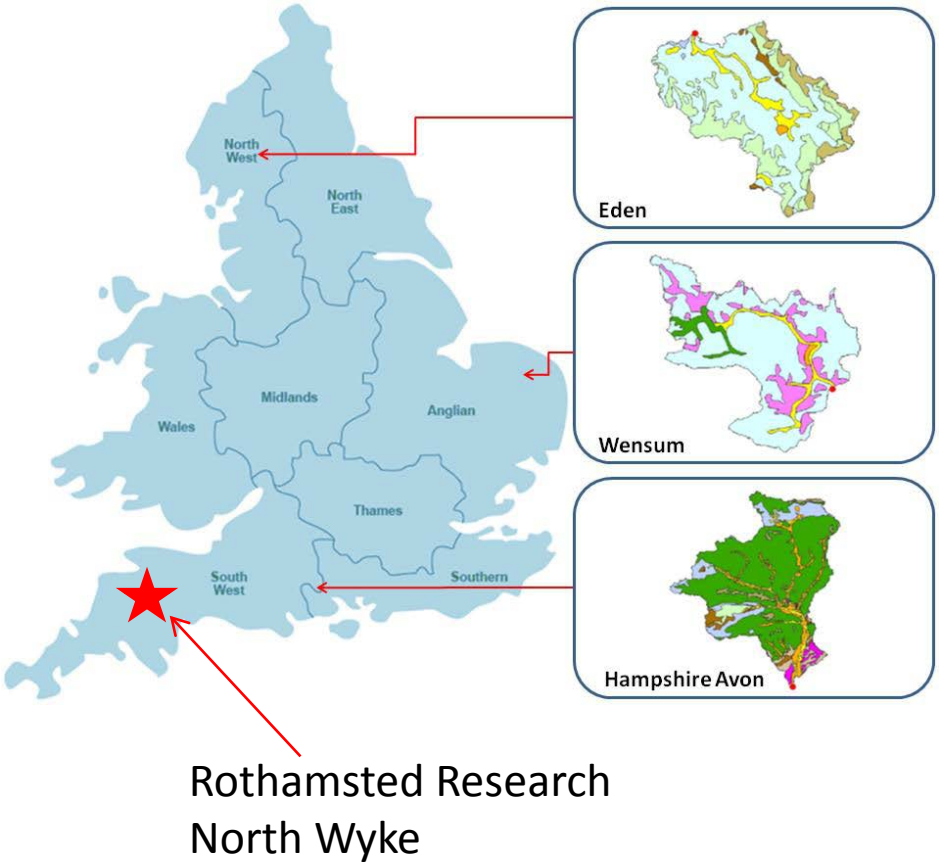
The Demonstration Test Catchment Project: P saturation project study sites

Total of 12 sites

4 in each catchment (Avon, Eden and Wensum)

Site Selection Criteria

- Age – 4 to >10 years
- Riparian buffer strip
- Arable land
- Soil Type – uniform within each DTC
- Slope – 3-7
- Width – 6m



Hampshire Avon Sites

NW Ref	Scheme	Age	Slope [b]	Width	Field Crop	Geology [a]	Soil Assoc [a]	Soil Description [a]
A1	ELS	4 yrs	4 %	6 m	Oats (harvested)	Glauconitic sand, loam & clay. (Greensand)	Ardington	Deep well drained fine and coarse loamy glauconitic soils
A2	ELS	5 yrs	4.5-6 %	6 m	Fodder Beans			
A3	CSS	7 yrs	4 %	6 m	Winter barley			
A4	CSS	>10 yrs	5.5-6 %	6 m	Wheat			

[a] Soil Survey of England and Wales (1983)
[b] Estimated in the field

Buffer A1: ELS- 4 yrs old, bordering Kennet and Avon Canal

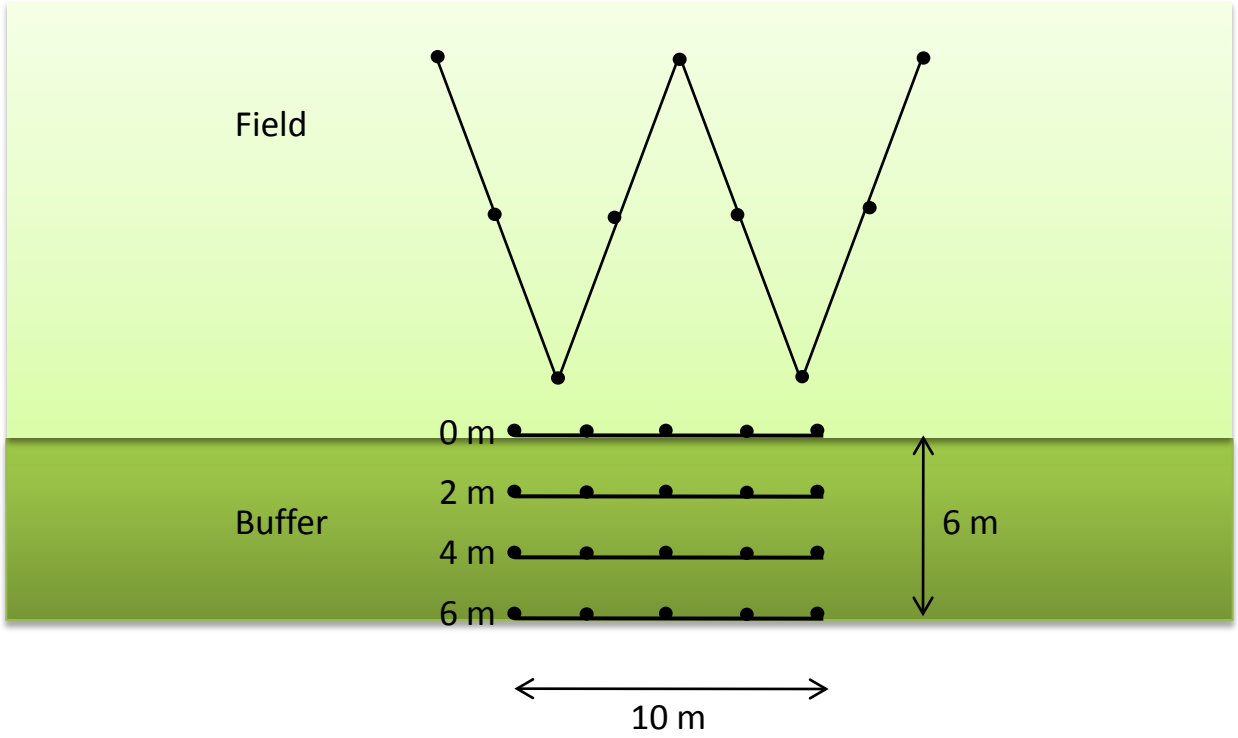
Buffer A2: ELS- 5 yrs old, bordering Deane water

Buffer A3: CSS: 7 yrs old, bordering Deane

Buffer A4: CSS- >10 yrs old, bordering Kennet and Avon Canal

Sampling Strategy

1 transect in field and 4 transects in buffer
3 sample depths per transect (0 -7 cm, 7-23 cm, & 23-30 cm)

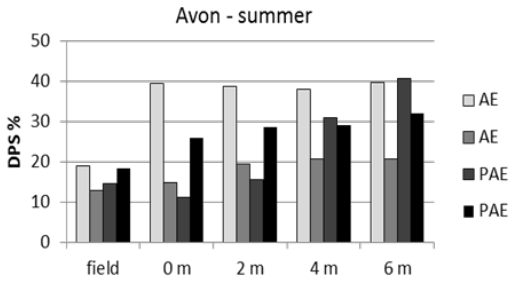


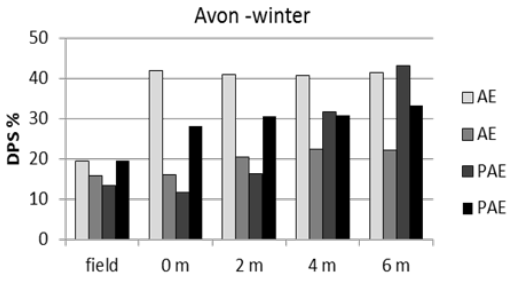
Field
Bulked soil sample at each depth from 9 sampling points

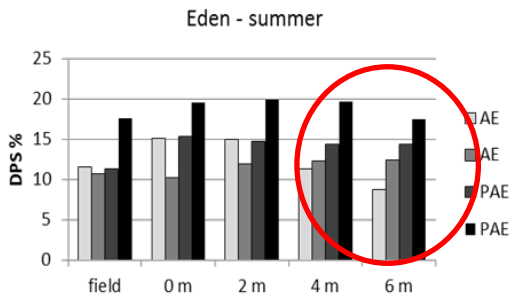
Buffer
For each transect:
Bulked soil sample at each depth from 5 sampling points

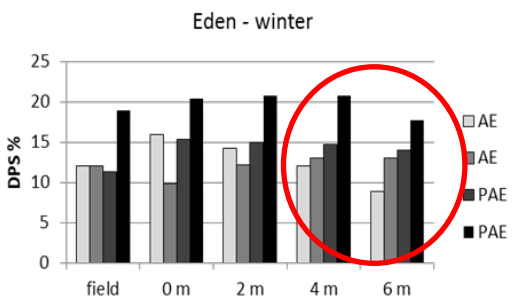
Total : 15 soil samples per site

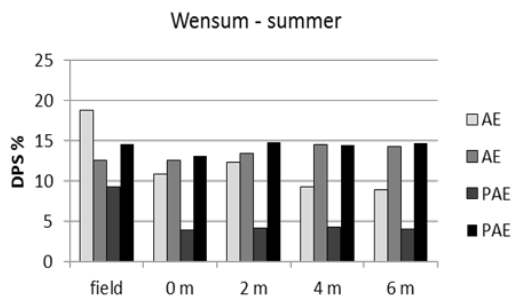
Summary from all sites
Degree of P saturation, mean from all depths, summer and winter

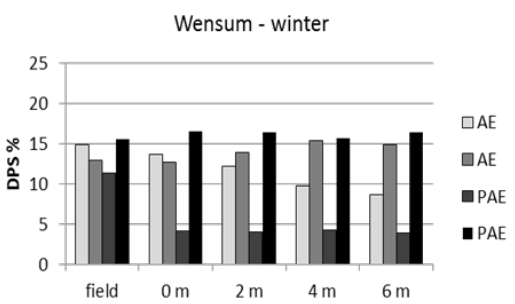












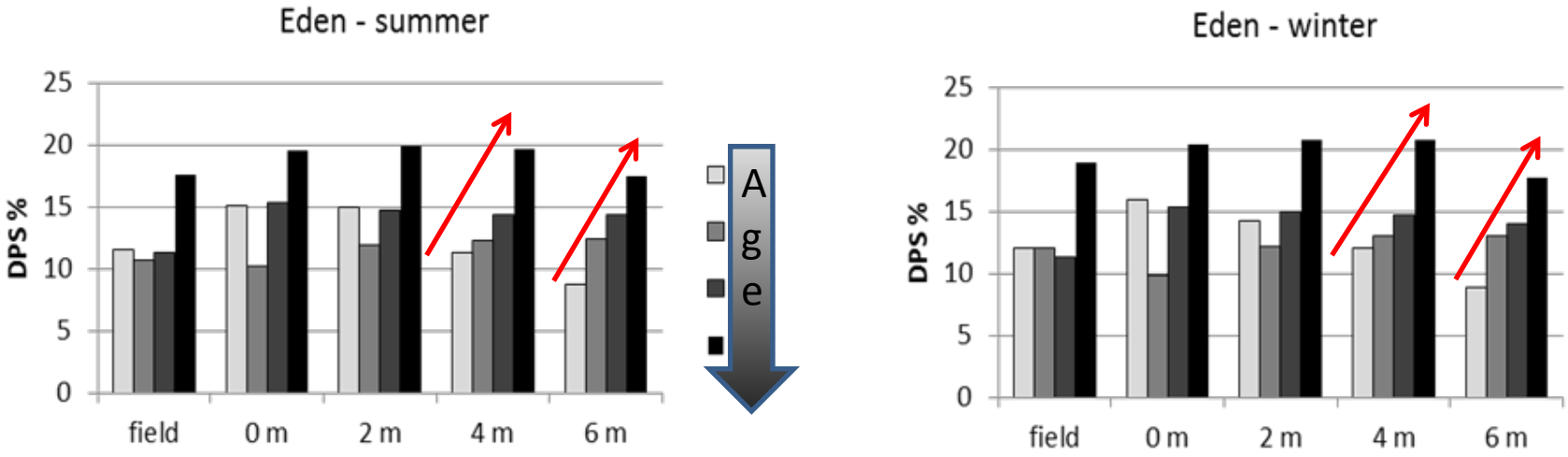
Range: 4% in Wensum to 41% in Avon

Generally not high (all < 50%)

What about age effects?

Eden catchment, winter, mean from all depths, degree of P saturation, %

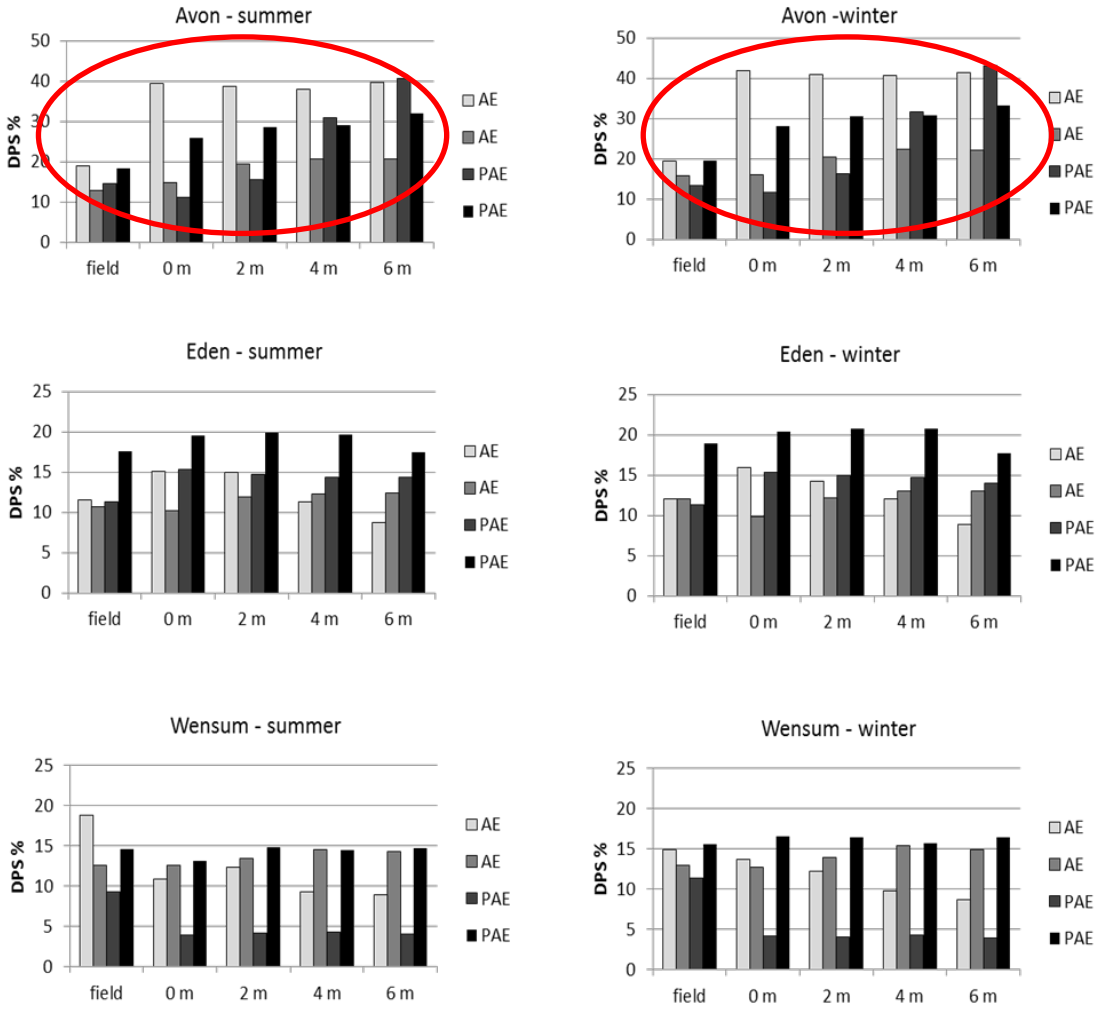
Effects of buffer age



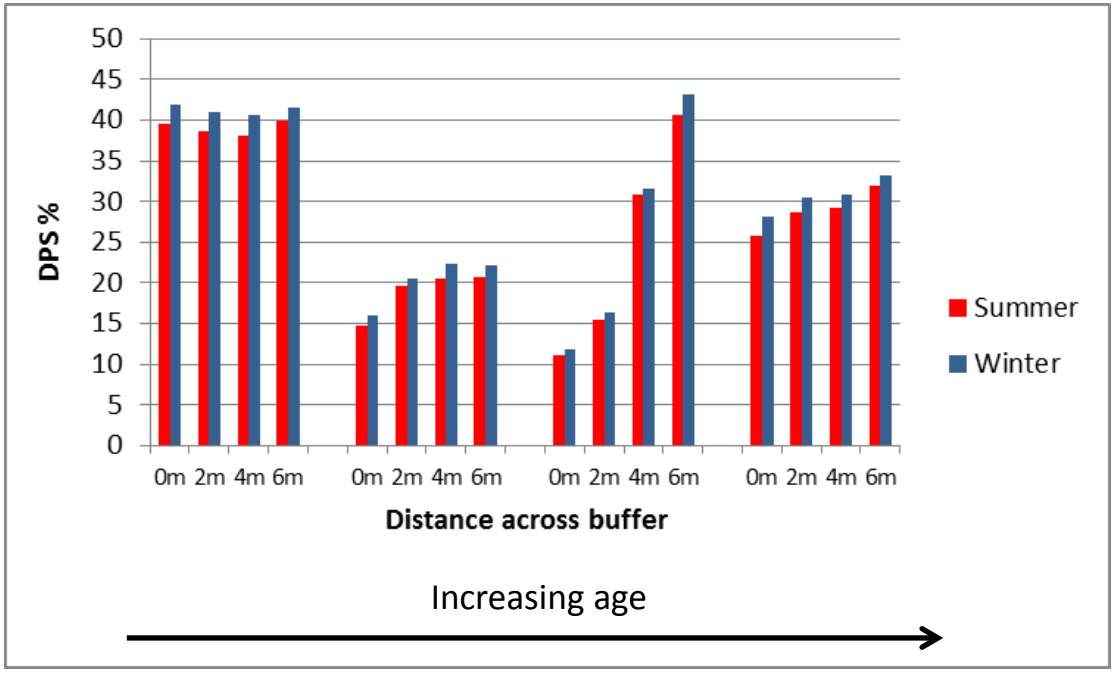
- At 4m and 6m, DPS increases with age
- Less obvious effect at 0m and 2m
  - Indication of increasing P saturation in older buffers

Degree of P saturation, mean from all depths, summer and winter

Seasonal variation

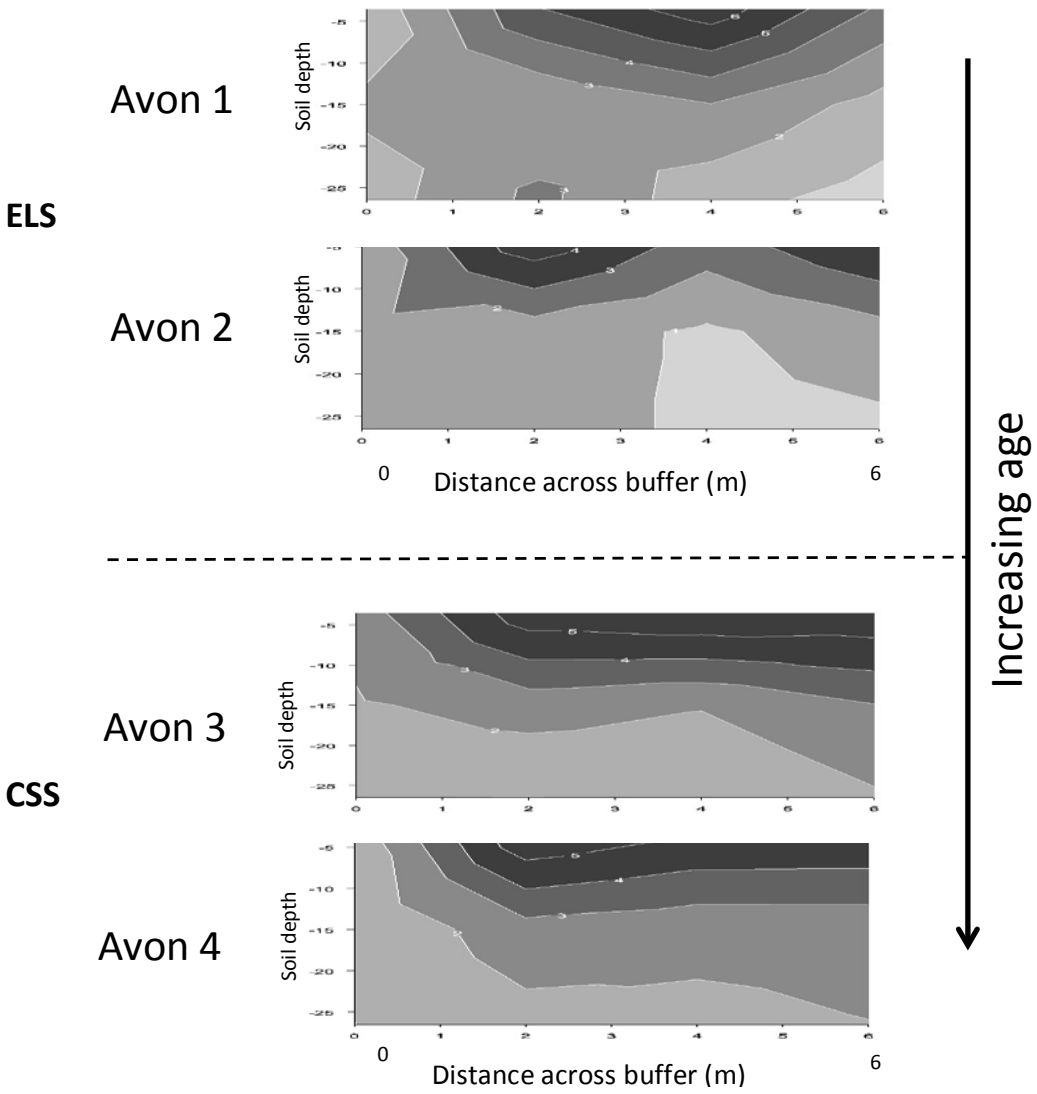


Avon sites: Effects of season and distance across buffer on DPS



- DPS increases with distance across buffer
- DPS greater in winter than summer by 0.7 to 2.6%
  - Is this accumulation or a seasonal discharge-recharge cycle?
    - DPS reduced in summer (uptake), increases in winter when more P is sorbed
  - If the latter, could be a process that prolongs the 'life' of a buffer for effective P trapping?

Water extractable (potentially leachable) total P in buffers in the Avon catchment (summer)



- Older buffers have an excess of water extractable P (potentially leachable)
- Younger buffers don't appear to be 'leaking' P
- Correlates with increasing DPS with distance across buffer at older sites
- Is 6m width enough?

Key points

- Some evidence that older buffers are more saturated with P
- None of the soils were highly saturated (4 to 41%)
- Need more research to identify whether this is a seasonal cycle or accumulation – plant uptake?
  - Must harvest vegetation
- 6m width might not be enough

However:

- Small dataset
- Have not considered hydrological pathways
  - Could have a large influence on capacity to adsorb P (preferential pathways could be saturated)

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