Soil sampling in the Garren Catchment

A report on some novel citizen science commissioned by WSA and delivered with help from CPRE

Objective: to measure soil phosphorus concentrations within the Garren Catchment and determine if they are increasing, as predicted by the recent RePhOKUs report (Withers et al. 2022)

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wye salmon association

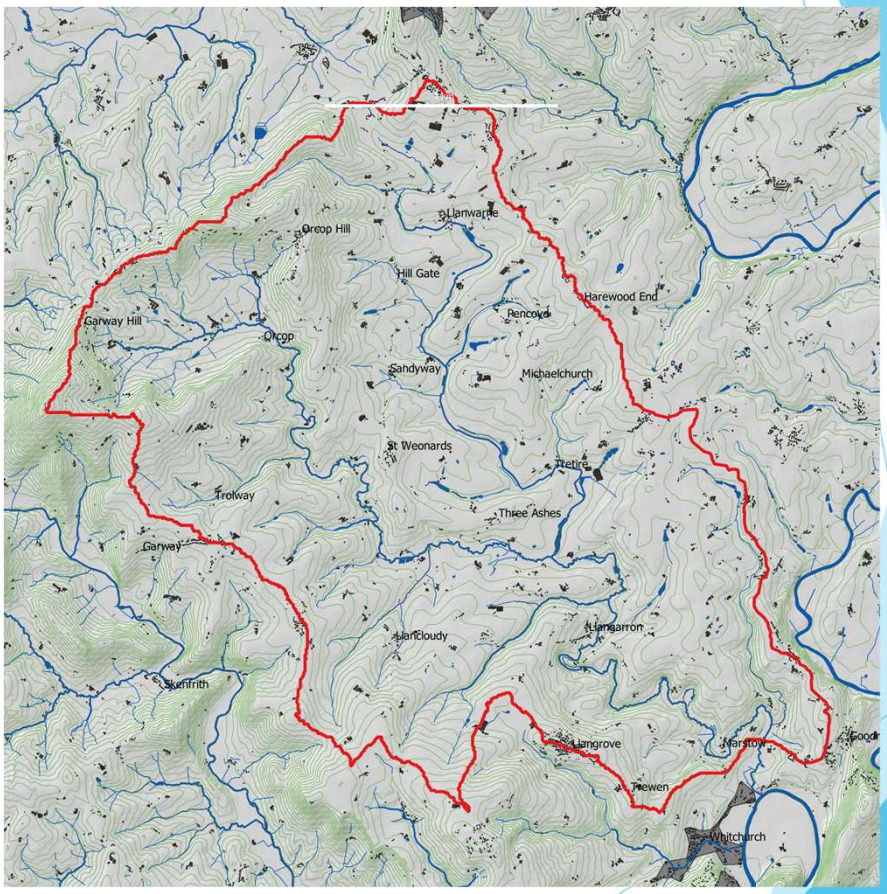
The Garren Brook

- A small lowland tributary of the River Wye
  - 29 km length
  - Joins the Wye between Goodrich and Symonds Yat
  - Tributaries: Gamber, Llanerch & Luke Brooks
- Groundwater fed, with high alkalinity
- Not within the Wye SAC, so WFD water quality targets apply
  - Achieves ‘good’ status for reactive phosphorus (RP) … just
  - High turbidity is severely impacting macrophyte and fish populations

Garren Brook from Langstone Bridge

The Garren Catchment

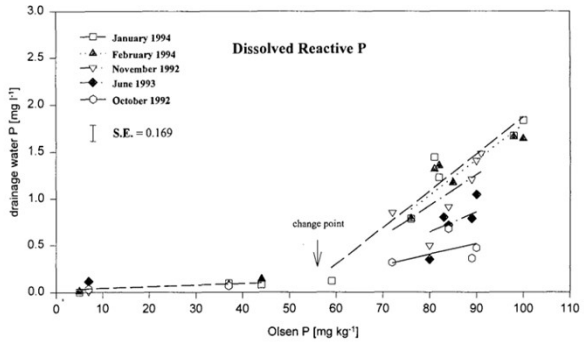
- 90 km^2 of Herefordshire farmland
- No major settlements
- Land use
  - Arable & horticulture 48%
  - Improved grassland 44%
  - Woodland 4%
  - Suburban 3%



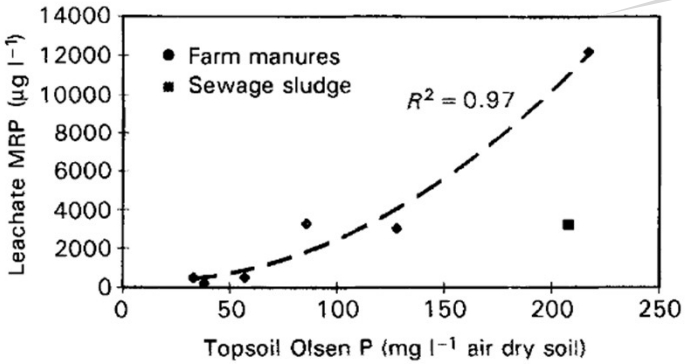
Why measure soil phosphorus?

- Soil P is a driving parameter for diffuse pathways
  - Groundwater leaching
  - Bulk soil erosion
- Groundwater leaching has a non-linear relationship with soil P

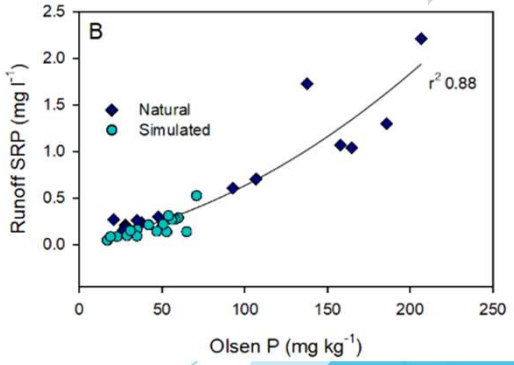
Wye soil



Heckrath et al. 1995



Smith et al. 1998



Withers et al. 2022

Olsen-P

- The Olsen test for phosphorus is widely used in UK agriculture
- It does not measure total phosphorus
- It approximates:
  - Plant-available phosphorus
  - Leachable phosphorus
- Olsen-P is used in soil nutrient guidance for farmers (ADHB RB209 series)

RB209 soil indices

Soil index	P concentration (mg/l)
0	0-9
1	10-15
2	16-25
3	26-45
4	46-70
5	71-100
6	101-140
7	141-200

- Target for grassland and most arable crops is index 2 (16-25 mg/l)
- Some vegetables (e.g. potatoes) target index 3 (26-45 mg/l)

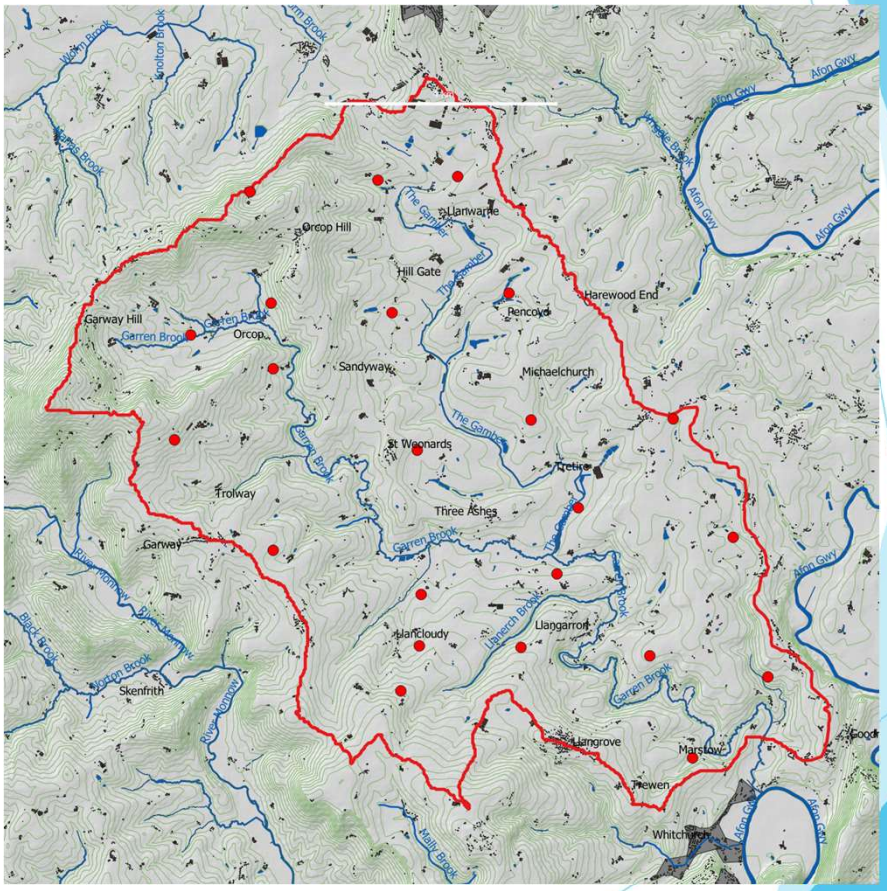
Baseline data

- Soil Olsen-P was last surveyed nationally as part of the Countryside Survey, 2007
- This is available as digital mapping data from the UK Centre for Ecology and Hydrology
- The data has been extracted across the Garren Catchment, yielding the following mean values:

Land use	Olsen-P (mg/l)
Improved grassland	31
Arable & horticulture	54

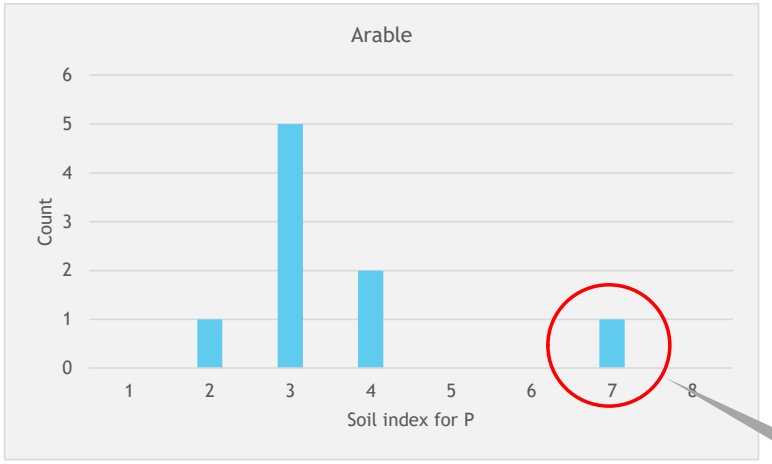
The sampling grid

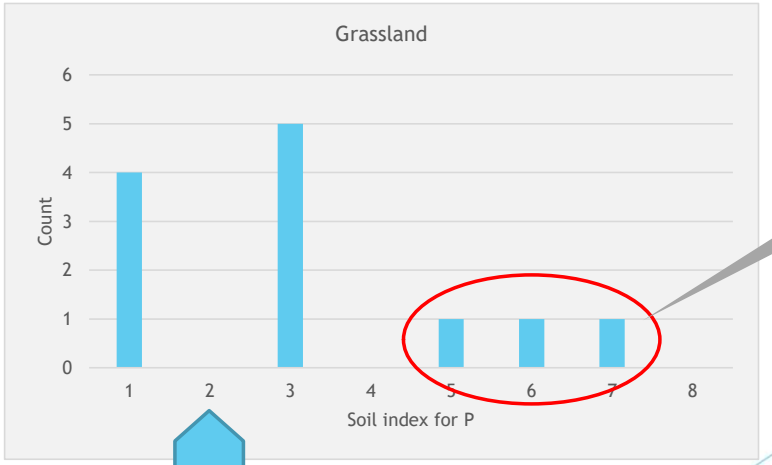
- 23 sites based on 2km x 2km grid
  - Adjust each sampling location to land on a field adjacent to the closest public footpath
- Sampling performed mid-June 2022
  - Soil collected using a standard 25mm diameter soil sampler
  - Sample depth as specified in RB209
- 22 samples sent for analysis



Olsen-P results

- Arable
  - average 54 mg/l
  - Same as 2007
  - 8/9 locations above target for crop (wheat, o/s rape, oats, maize)
- Grassland
  - Average 48 mg/l
  - 17 mg/l increase from 2007
  - 8/12 locations above target
- Orchard
  - 1 site at Index 1



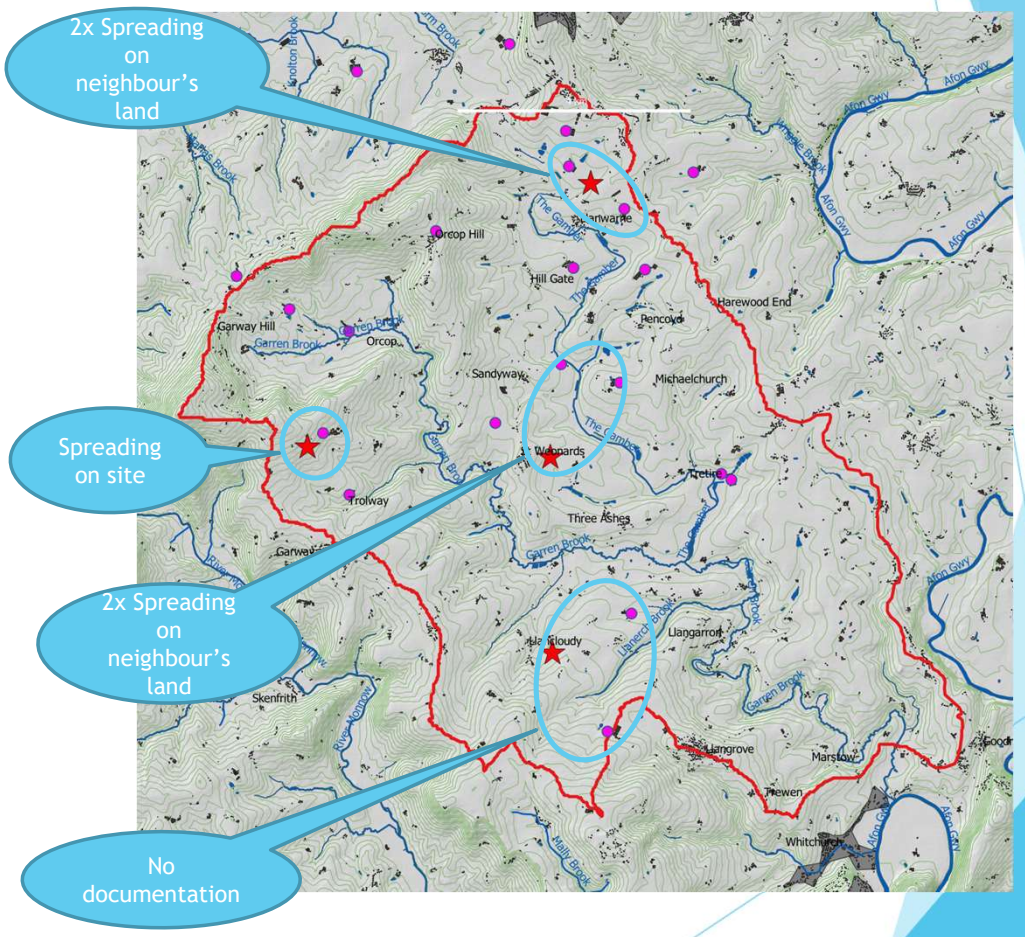


Note
4 outliers

Target
index

Outlier locations

- All outlier locations are in proximity to one or more IPUs
- There are ≈17 IPUs in the catchment, containing over 2M birds
- Manure management plans are informative
- The majority of IPUs either spread on site or on neighbours' land, often at the NVZ maximum rate for N



Conclusion

- Arable land is well above target index, but appears stable
- Grassland is the principal challenge (as found by RePhOKUs)
  - Mean Olsen-P increased from 31 mg/l (index 3) in 2007 to 48 mg/l (index 4) in 2022
  - Livestock farmers have a lot of manure to dispose of
  - A high concentration of IPUs adds significantly to this burden
- 4 sites at index 5-7 correlate with IPU locations and spreading practices
  - These result are consistent with spreading at NVZ maximum rates for 15-20 years
- To reduce diffuse phosphorus pollution we need to reduce soil phosphorus:

… therefore we must measure it