



**South West
Water**



Mires and Upstream Thinking: Catchment restoration and recovery in the South West

Dr David Smith – South West Water



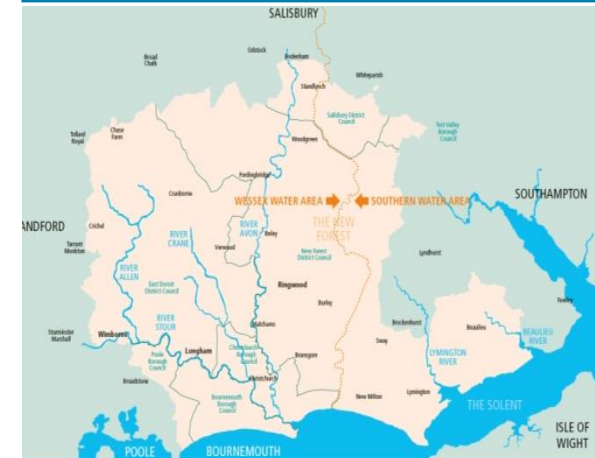
SOUTH WEST WATER REGION AND RESPONSIBILITIES



- 903,000 Household Customers
- 70,000 businesses
- Dispersed population
- Many tourists – pop. swells to 8m in summer
- Drinking water quality 99.98% to 99.99%
- A unique environment:
 - 35% of England's designated bathing waters*
 - 19% of England's designated shellfish waters*
 - National Parks, ANOBs, SACs, Biosphere Reserve, NIA, etc*
- **90% of drinking water from surface waters**



Bournemouth Supply area



SWW ENVIRONMENTAL RESILIENCE CHALLENGES



Flooding



Drought



Raw water quality

Upstream Thinking



Flagship environmental project
£9m (2010-15) £10.5m (2015-20)

Partnership delivery

2 strands of work:

- moorland restoration
- agricultural improvements

Cornwall
Wildlife Trust 


Devon


Westcountry
Rivers Trust



Improving natural water
quality and water storage in
the landscape

Upstream Thinking: on the farm

Working with farmers and landowners to **minimise impact on watercourses**



Upstream Thinking: reducing organics from farming



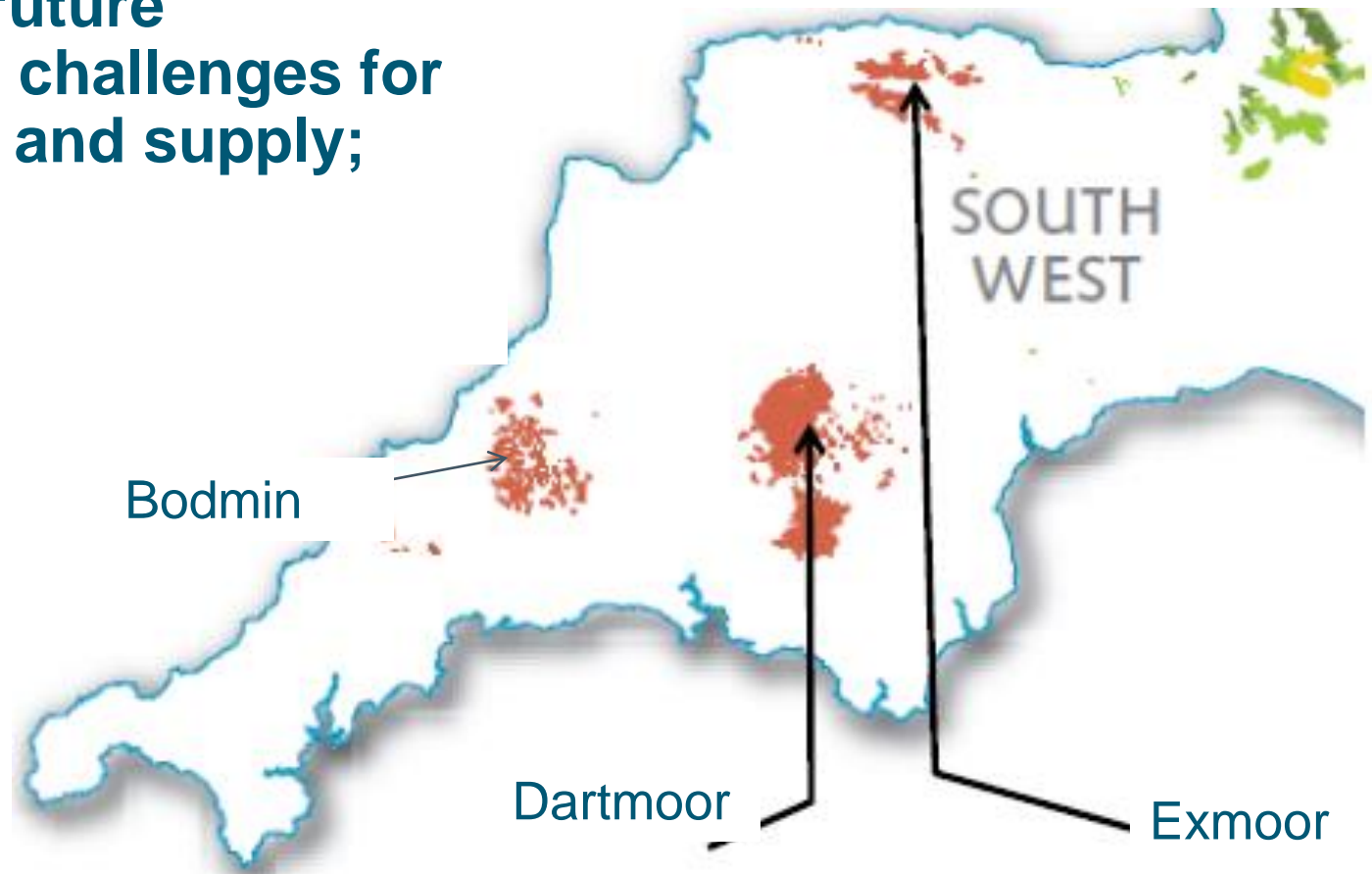
Upstream Thinking: on the moors



Upland catchments are critical for raw water supplies.

Current and future management challenges for water quality and supply;

Climate change
Changing rainfall
Peatland loss
DOC
Geosmin
Sediment



Most of Exmoor's peatlands have been affected by past peat-cutting, drainage, burning and grazing: Heavily modified, dry and dominated by Molinia.



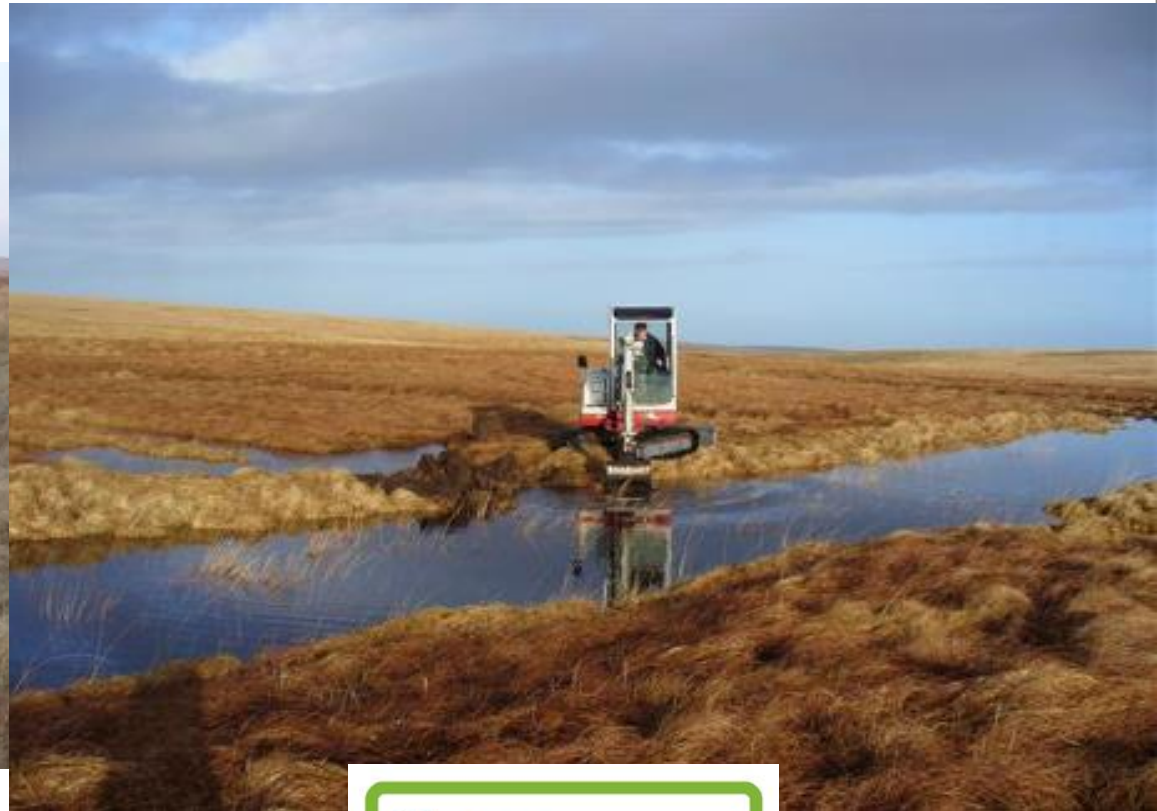
Severe erosion Winney's Down Area 1



Bodmin Moor peatland: degraded western climatic mires within reservoir draw down zones



Hydrological restoration by blocking up ditches, cuttings and gullies



Simple practical solutions

Peat blocks, sometimes wood or bales



**Blackpitts; peat cuttings blocked in 2007.
Over 200 wet pools created in a dry landscape.
Now the best upland dragonfly site in Somerset.**



NT Holnicote – Flood Risk Management project



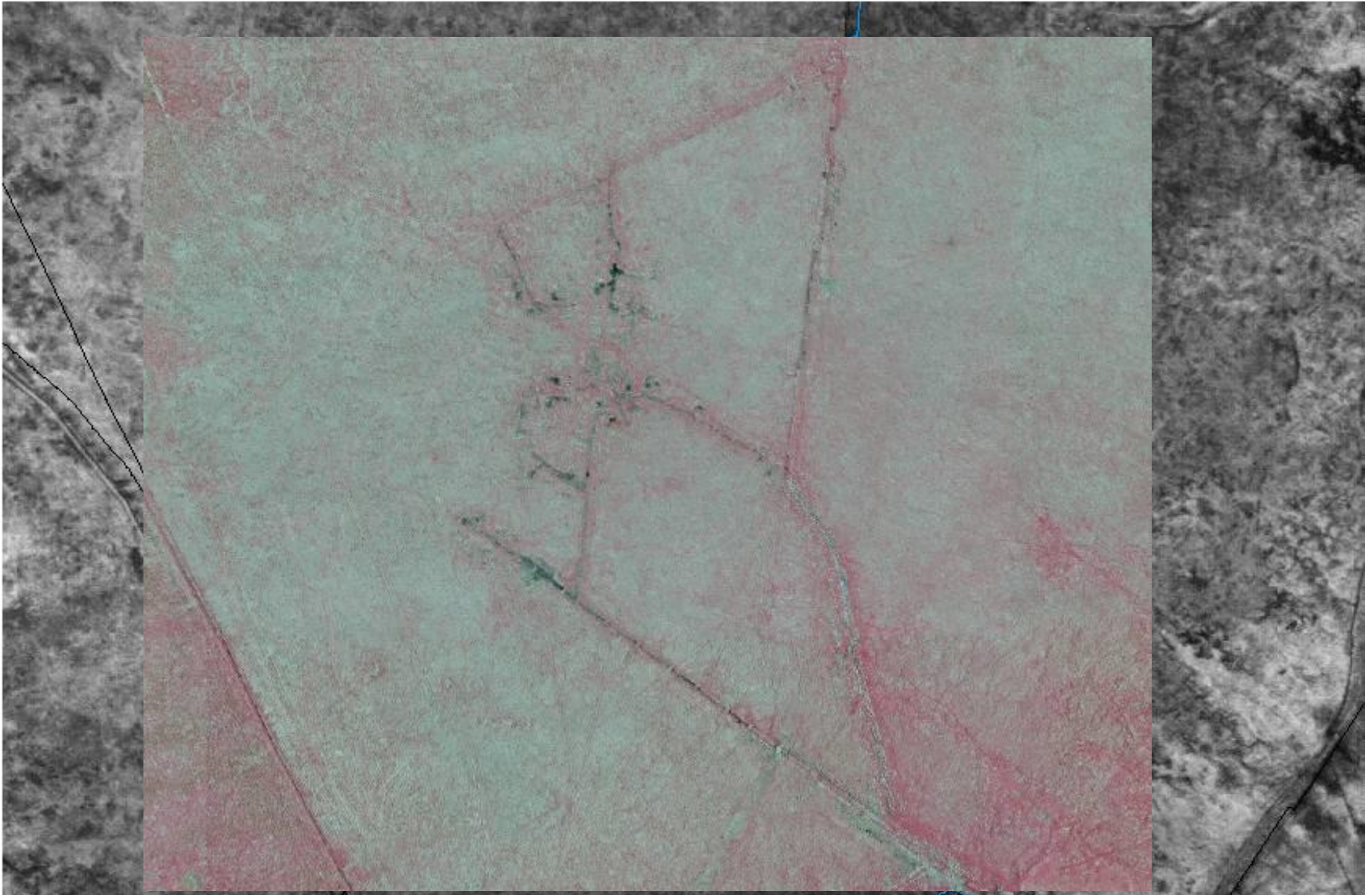


South West Water

Exmoor restoration of pre 20c drainage



Restoration of post war drainage



Eroded area immediately after restoration



Monitoring Restoration recovery: Results from Exmoor



Monitoring results: methods

- Storm-flow sampling (ISCO pump sampler)
- DOC measurements (UV spectrophotometer)
- Colour: UV - vis Spectrometer

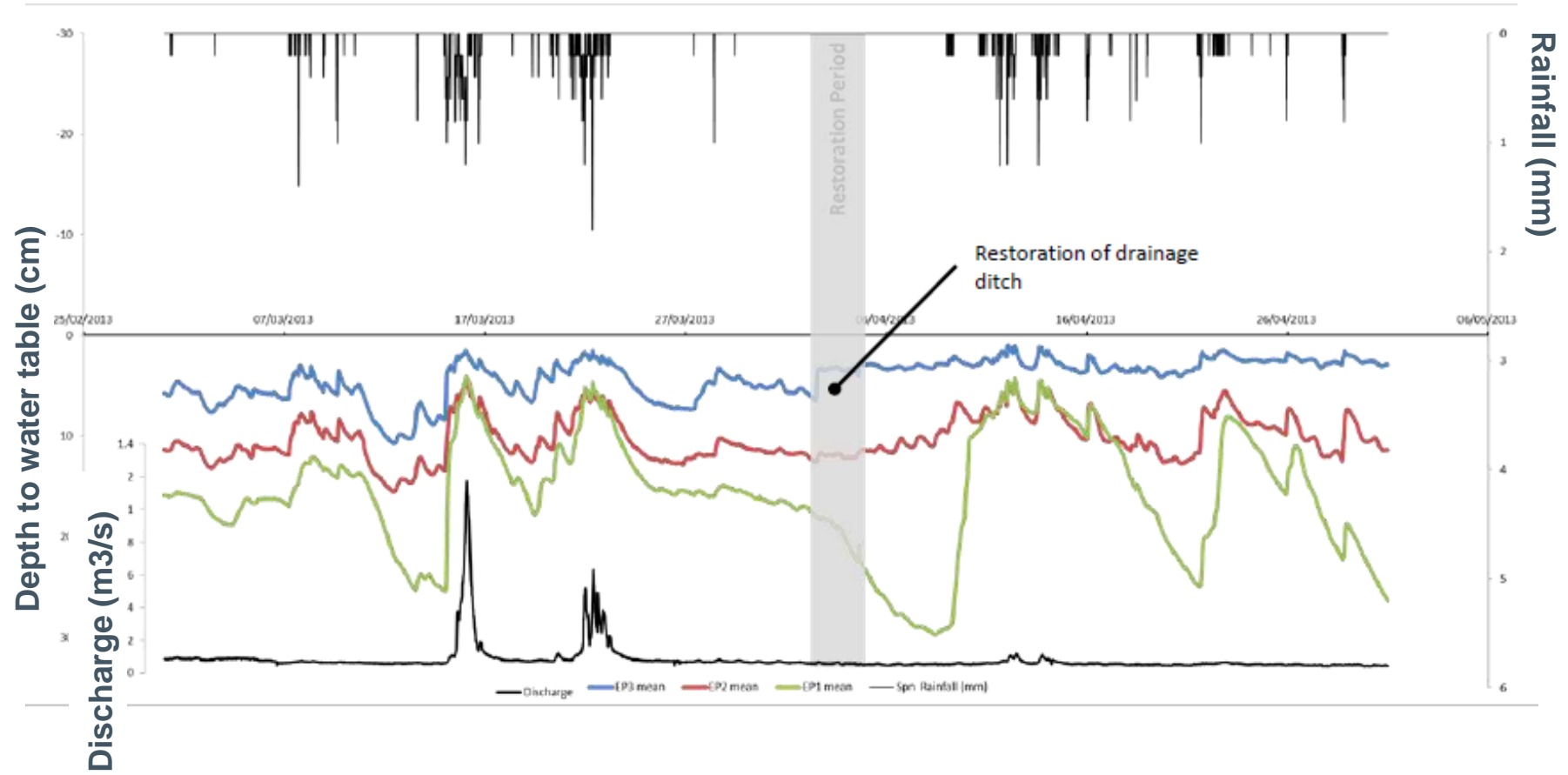
Abs 400 nm

Fulvic / Humic ratio (E4/E6)

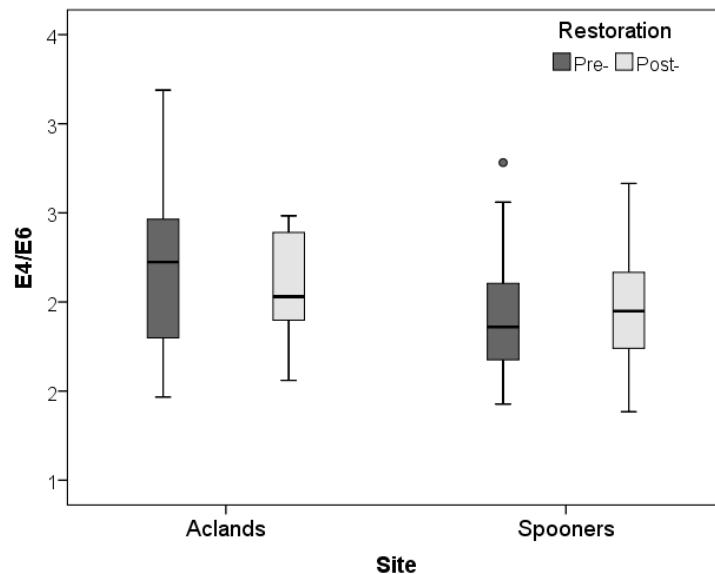
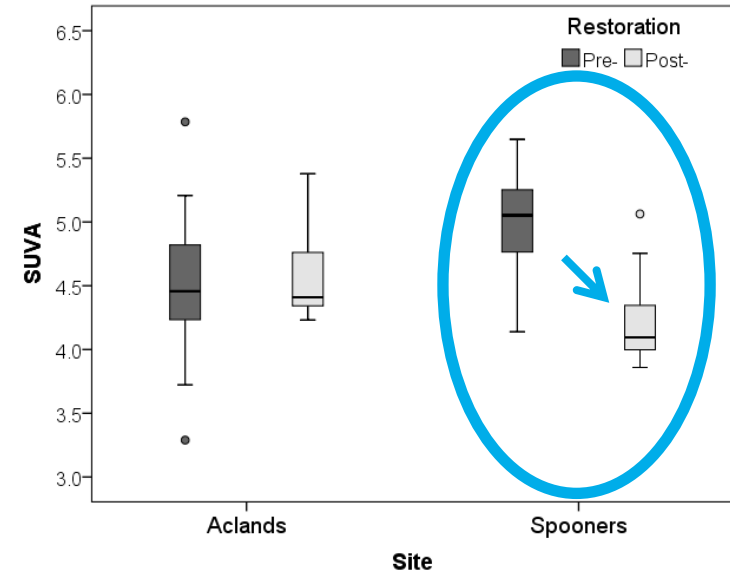
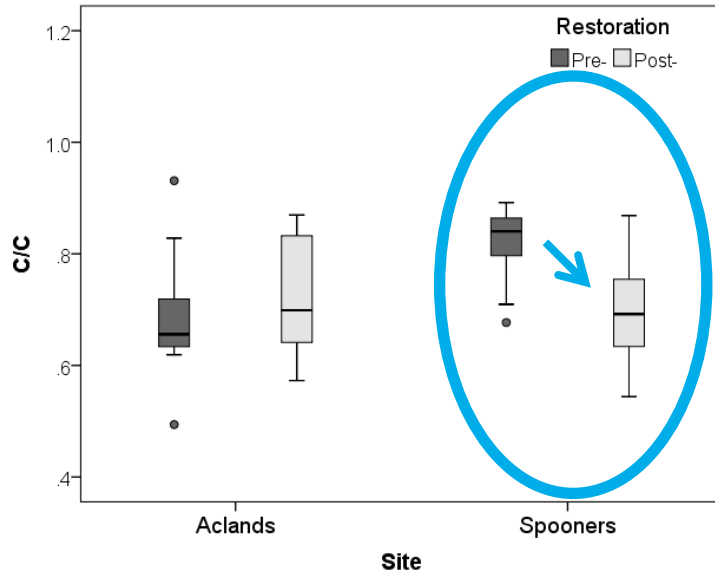
SUVA



Monitoring results: water storage

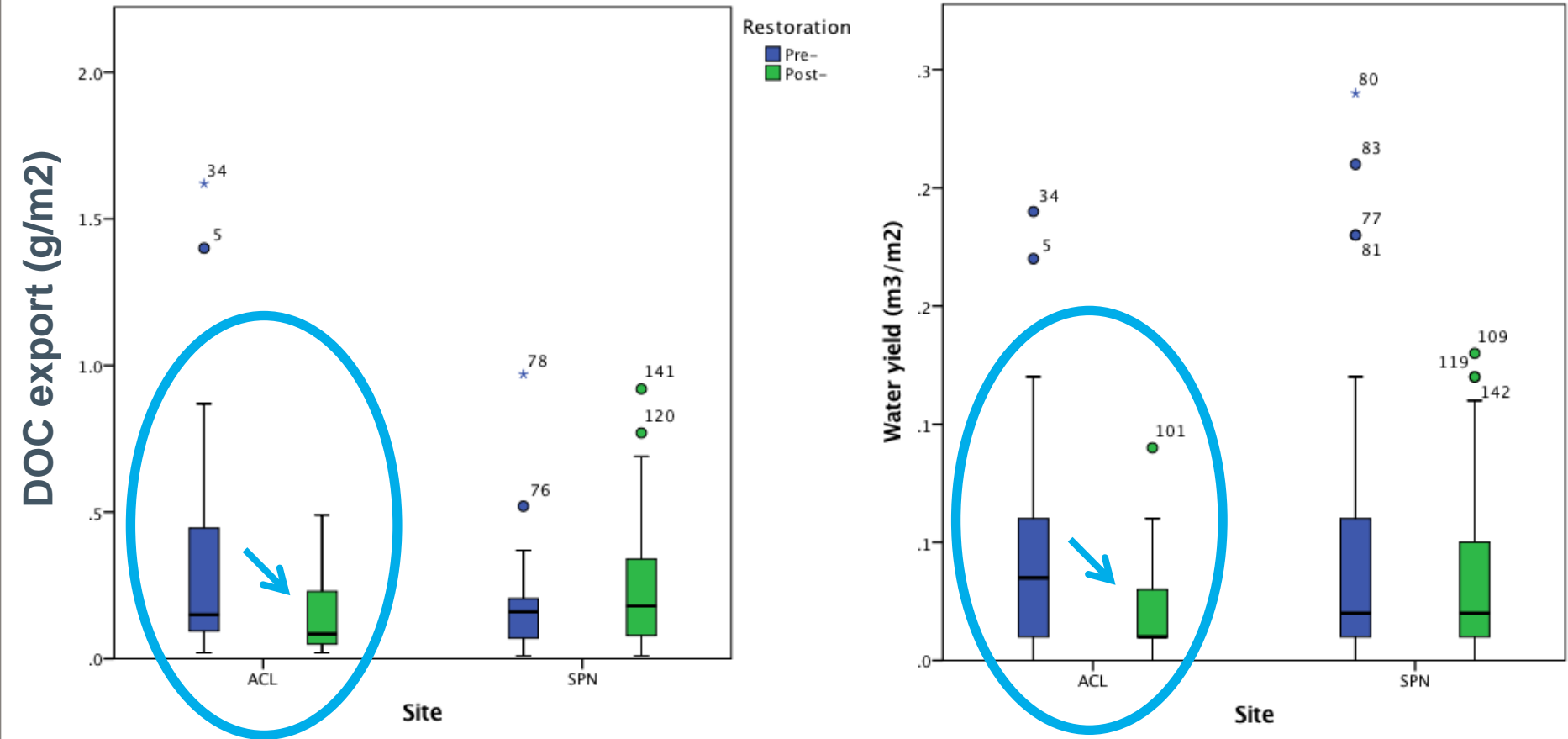


Monitoring results: DOC characteristics



- DOC becoming less discoloured after restoration
- No change in humification index
- DOC becoming more hydrophilic

Monitoring results: Fluxes



Load (kg) = [DOC] x Q

- Decreased export at Aclands during events monitored

Conclusion

- Significant increase in DOC and colour concentrations following restoration;
- C lost is more hydrophilic post-restoration;
- Reducing DOC export requires successful water storage.

GHG flux and storage monitoring



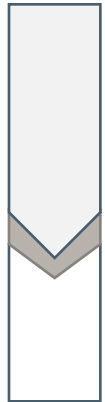
South West Water

Internal balloon (to dampen pressure changes)

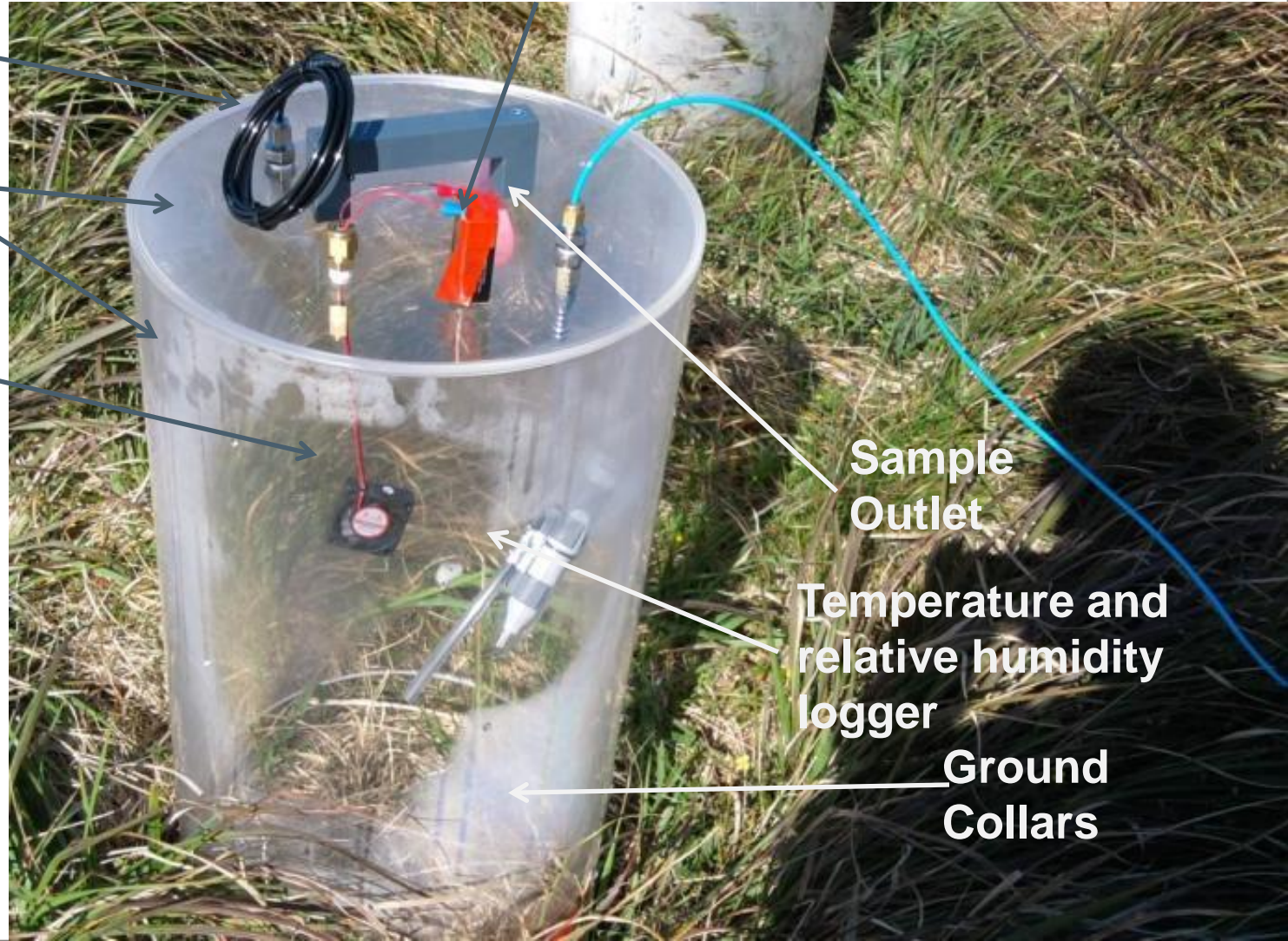
Vent Tube

Lid & chamber

Fan to mix chamber air



Chamber, lid and collar are sealed using a water-filled groove

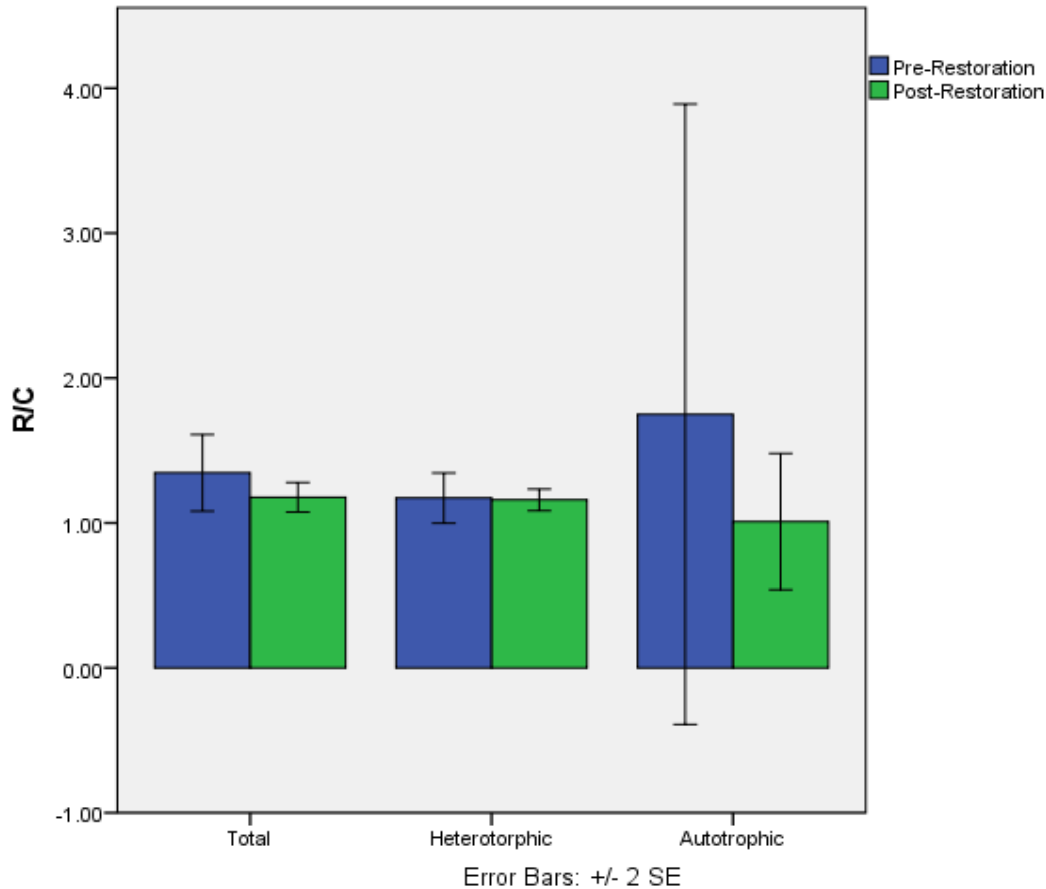


Sample Outlet

Temperature and relative humidity logger

Ground Collars

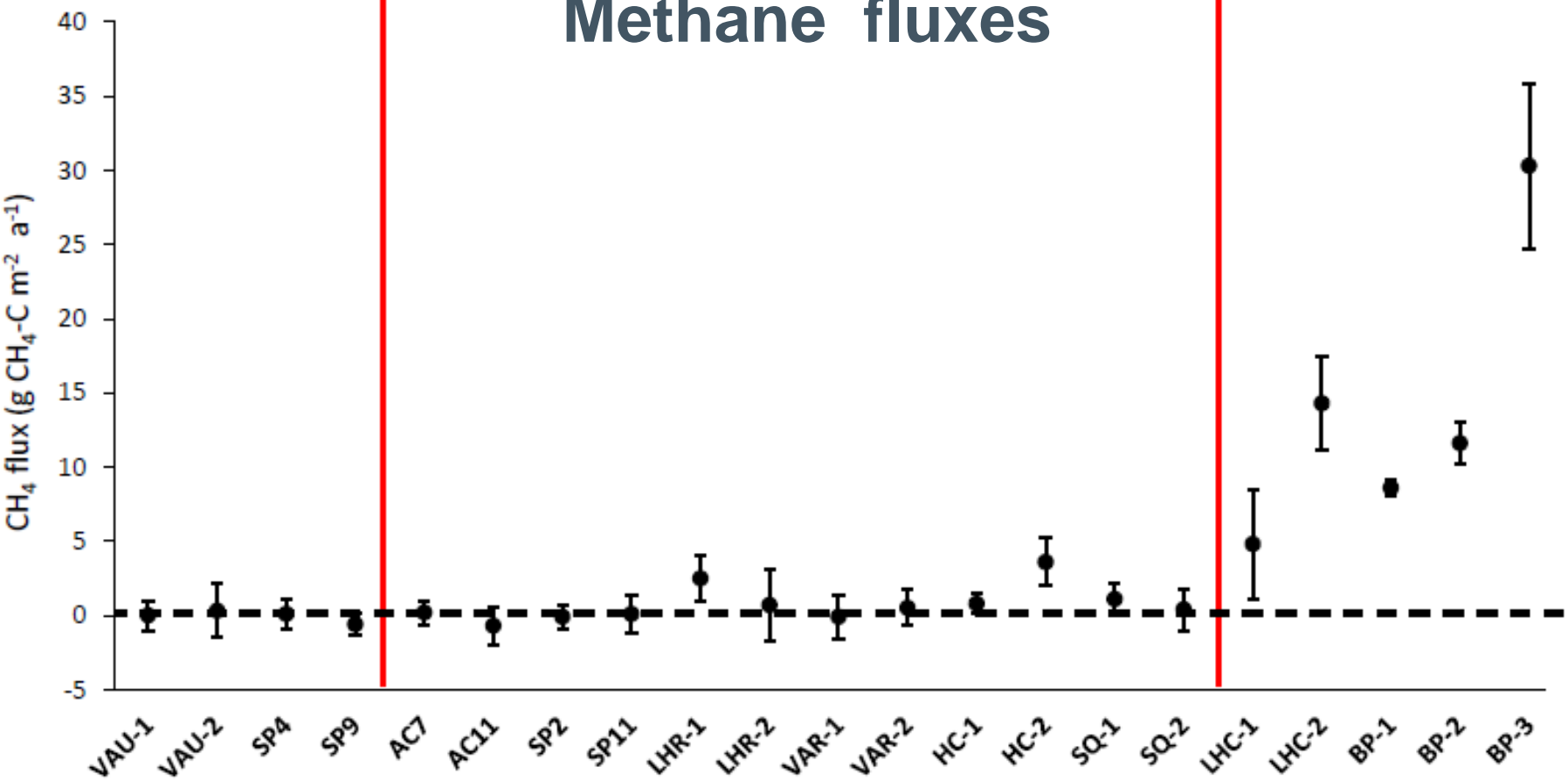
Spooners post-restoration data



Effects of restoration on total, heterotrophic and autotrophic below-ground respiration

CO₂ fluxes - no significant changes post restoration so far...

Methane fluxes



Unrestored

Restored

Wet Control

Restoration age

Youngest
(6 months)

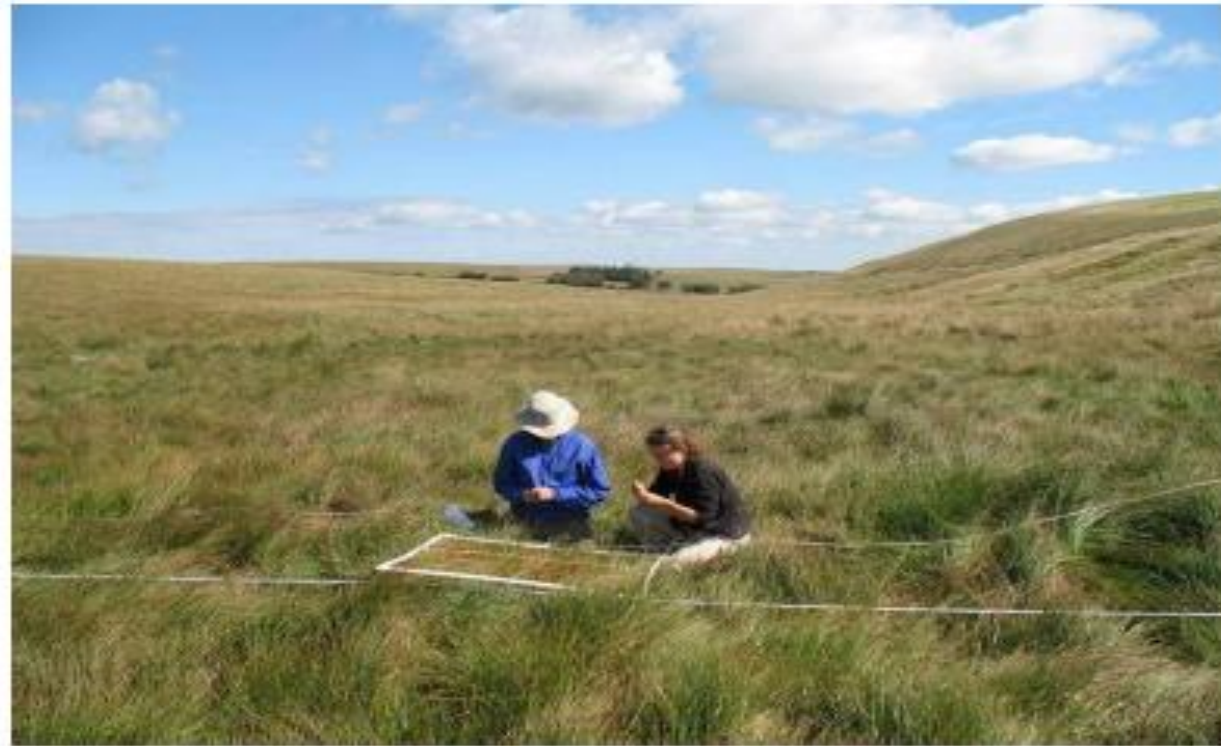
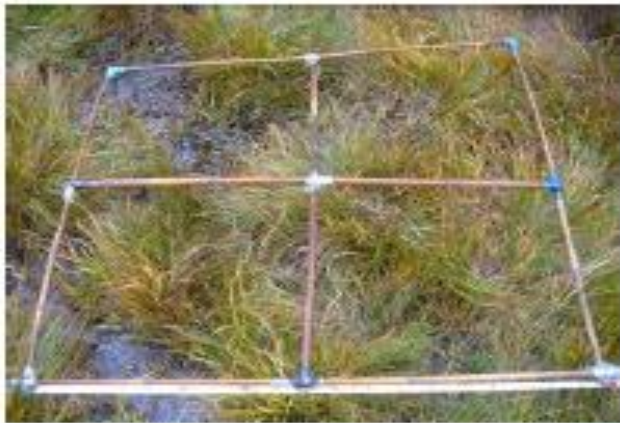


Oldest
(~ 7 years)

Vegetation Monitoring Results

Increased mire species (e.g. *Sphagnum*) and less moor grass (*Molinia*)

Community changes (NVC) to wetter mire types



Base line Vegetation transect Surveying at Exe Head

Vegetation monitoring



Site	1998	2006	2007	2008	2009	2010	2011	2012	2013	2014
Exe Head	Red	Red	Yellow	Red	Green		Red			SURVEYED
Blackpitts 1	Red	Red	Yellow	Red	Red		Red			SURVEYED
Blackpitts 2		Red	Yellow	Green	Green		Green			SURVEYED
Exe Plain		Red	Yellow	Red	Red		Green			SURVEYED
Roostichen		Red	Yellow	Green		Green			Green	
Broadmead		Red	Yellow	Red		Red			Green	
Squallacombe		Red	Yellow		Green		Green			SURVEYED
Aldermans Barrow		Red		Yellow		Red			Red	
Roostichen 2		Red		Yellow		Red			Red	
Upper Exe Valley		Red	Red	Yellow		Red	Green			
Comerslade			Red	Yellow		Yellow			Green	
Hangley Cleave 2			Red	Yellow		Red	Green			
Hangley Cleave 1			Red	Yellow		Green	Green			
Long Holcombe 1			Red		Yellow		Green			
Long Holcombe 2			Red		Yellow		Red			
Vernie's Allotment			Red	Yellow			Red		Green	
North Twitchen			Red		Yellow		Red			SURVEYED
Homer Common					Red	Yellow			Green	
Aclands 1							Red			Yellow
Aclands 2							Red			Yellow
Chains 1							Red		Yellow	
Chains 2							Red		Yellow	
Chains 3							Red		Yellow	
Huntercombe							Red	Yellow		SURVEYED
Lucott Moor							Red	Yellow		SURVEYED
Prayway Meads							Red			Yellow
Spooners NS							Red		Yellow	
Burcombe							Red		Yellow	SURVEYED
Lanacombe 1								Red		Yellow
Lanacombe 2								Red		Yellow
Pinkery 1								Red	Yellow	
Pinkery 2								Red	Yellow	
Pinkery 3								Red	Yellow	
Pinkery 4								Red	Yellow	
Pinkery 5								Red	Yellow	
Pinkery 6								Red	Yellow	
Deer park								Red		Yellow

Red sites in unfavourable condition (NVC)

Yellow ditch blocking

Green improved sites (NVC)

Other Biodiversity monitoring (Birds, dragonflies, amphibians)

have also shown positive changes

Dragonflies example is typical of increases;

Black Darter- (rare on Exmoor as it needs bog pools) Blackpitts now has the largest population in Somerset



Restoration created new Snipe habitat which did not exist before 2008



- A strong association of bird sightings with wet-pool restoration areas (e.g over 30 sightings on Blackpitts)
- 2 new breeding territories at Blackpitts.

Quantifying moorland management implications

Effect on grazing – more diverse sward but is it more grazable?

Any stock reductions or live weight gain loss?

Stock access and management implications?

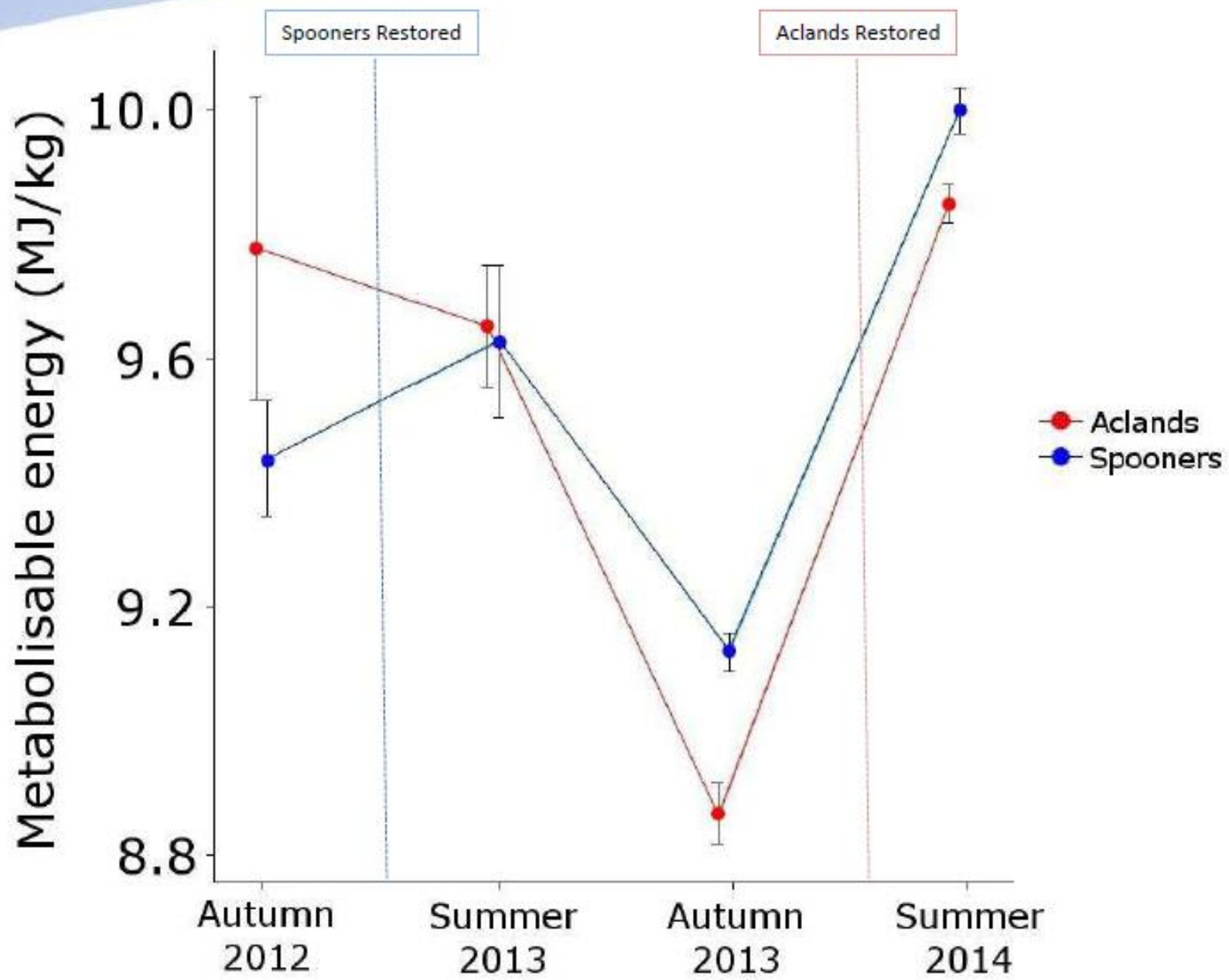
Drinking water for stock benefits

Effects on parasites (ticks and flukes)

Effect on local economy- farmers and local contractors can do the work

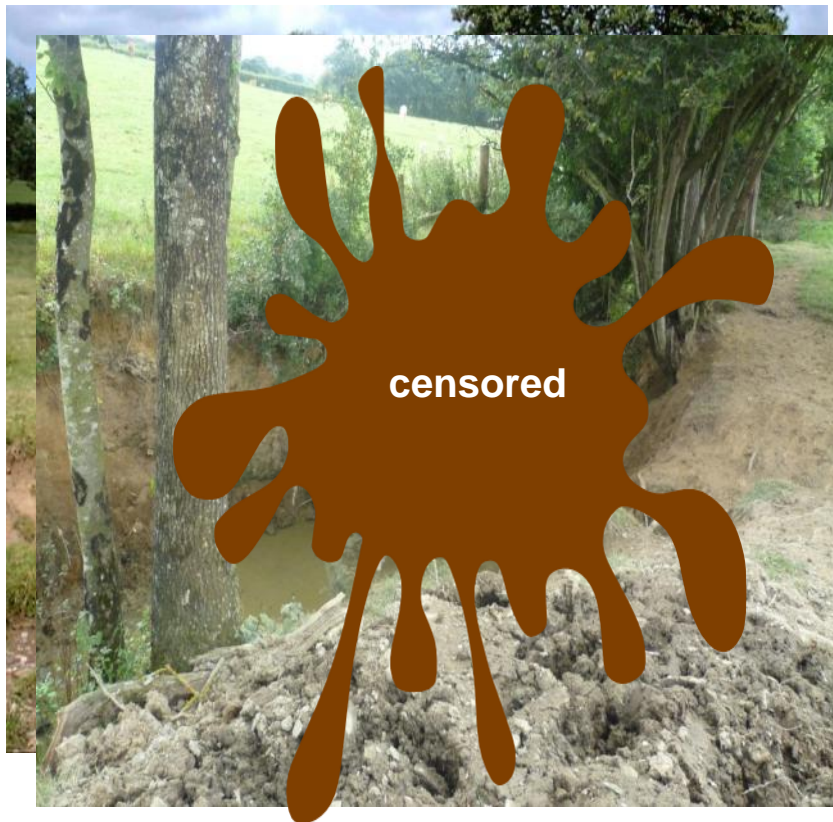


Site Results: Metabolisable Energy



Upstream Thinking: on the farm

Diffuse pollution



Low cost improvements





Biodiversity

Upstream Thinking: Culm



- Culm grassland restoration and management
- Improving productive grassland and soil management
- For water, wildlife and people





THANKYOU

www.exmoormires.org

Morag Angus- Project TEAM

Emilie Grand-Clement – Moorland Research Associate (KTP)

David Luscombe- UoE PhD student (water storage and quality)

Naomi Gatis – UoE PhD student (carbon and hydro relations)

Adam McAleer - Bristol University NERC PhD student (GHG fluxes)

Guy Freeman- Exeter University PhD on Agricultural Impacts

And our volunteers, interns and moorland farmers.