

Regional vs local drivers of water quality in the Windermere catchment



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Regional synthesis of algal community change in lakes and tarns of the Windermere catchment, Lake District, UK since the 19th century

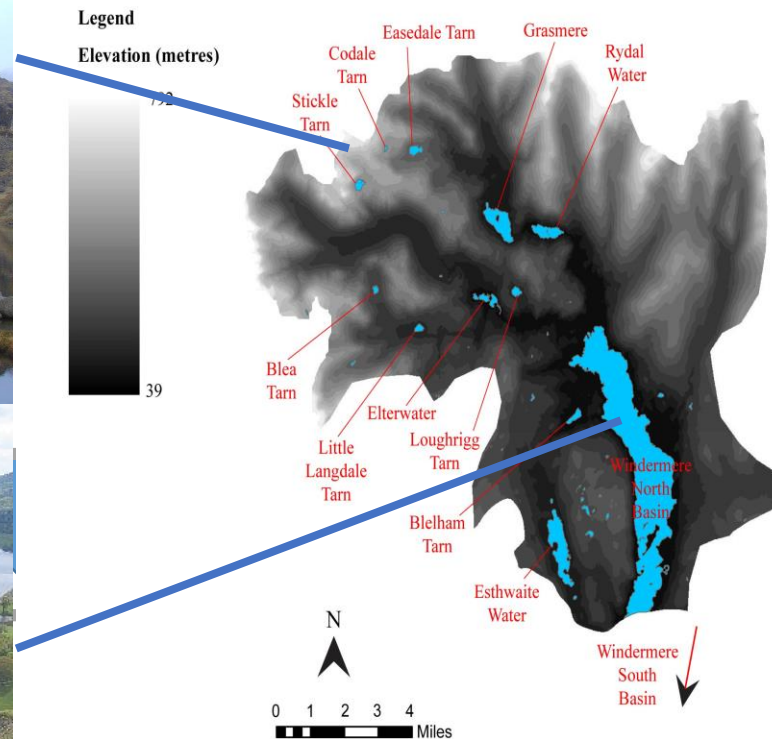
Increase in algal blooms



A landscape-scale palaeolimnological investigation into the multiple spatial and temporal forcings of algal community change



5m Digital Terrain Model for the North Windermere/Brathay catchment featuring the 11 sample sites.



Dataset: 5m Digital Terrain Model. Supplier: Bluesky
Citation: © Geoperspectives supplied by Bluesky 2013
Dataset: Waterbodies and river catchment boundary.
Supplier: Environment Agency

Algal pigments – proxies of environmental change

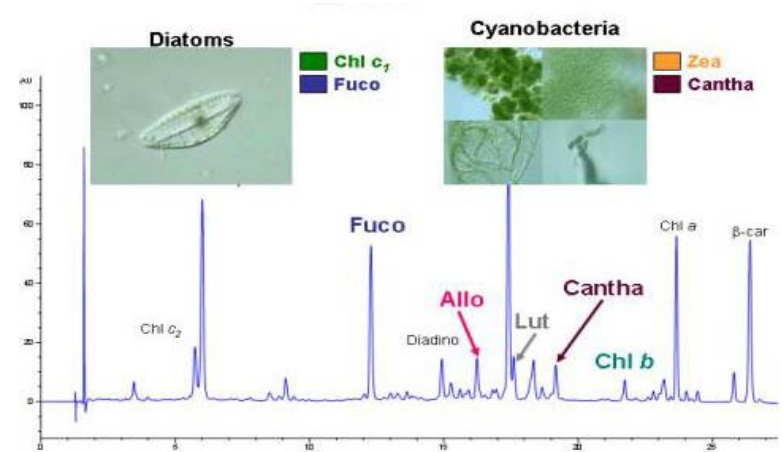
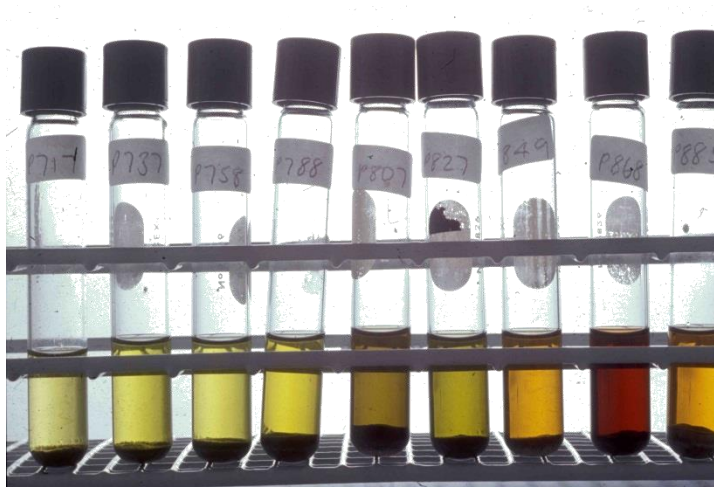
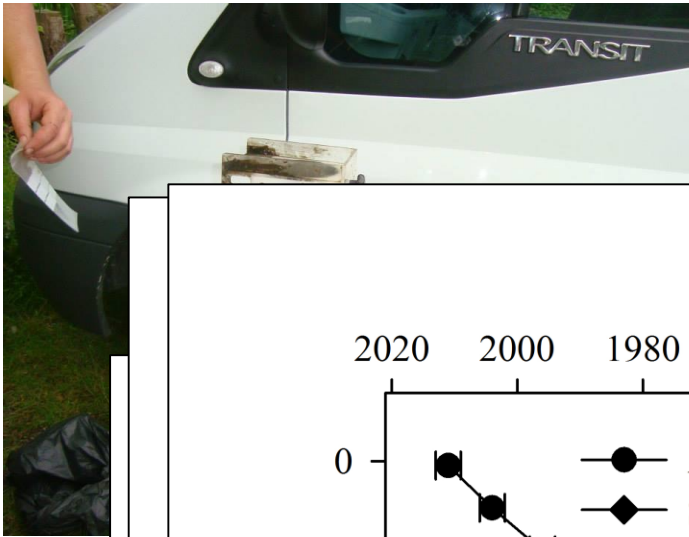
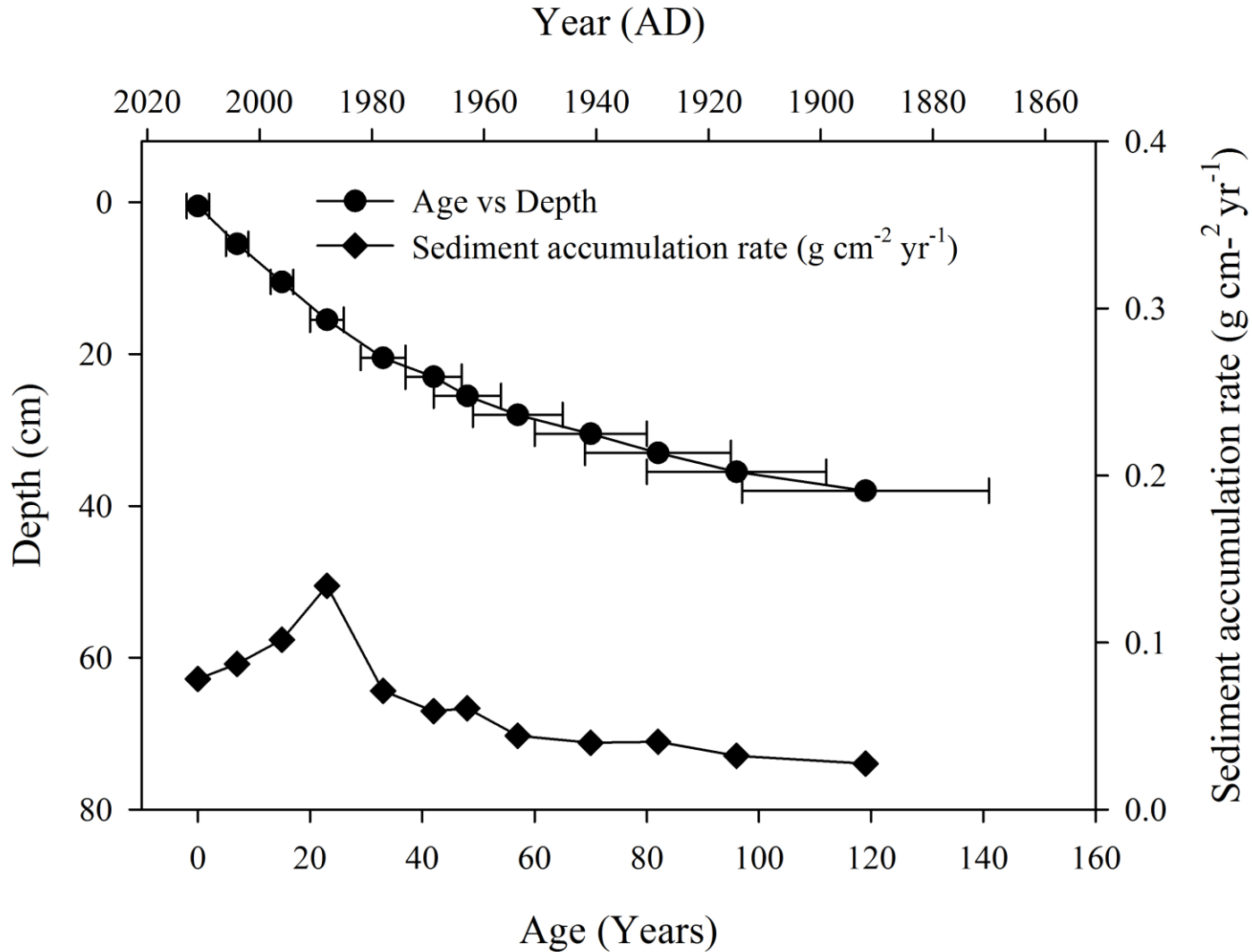


Image : <http://www.dnr.sc.gov/ael/research/pigments.html>

- Found in all photosynthetic organisms
- Chlorophylls and carotenoids (light-absorbing compounds)
- Often only biochemical compound remains of photosynthetic organisms
- Taxonomically specific
- Separated, identified and quantified using HPLC (High Performance Liquid Chromatography)

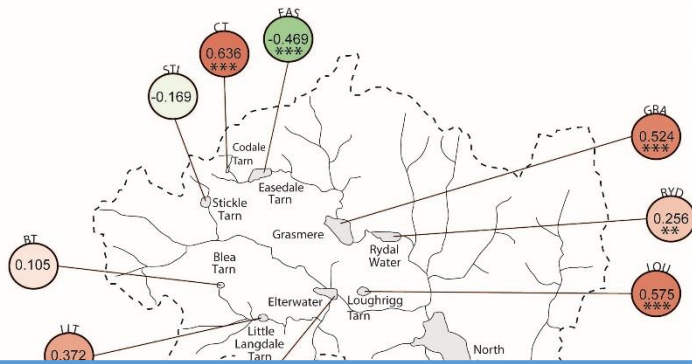


Lowlands: Windermere North and South, Esthwaite Water, Rydal Water, Blelham Tarn, Grasmere, Loughrigg Tarn, Elterwater Inner basin.
Uplands: Stickle Tarn, Codale Tarn and Easedale Tarn



How have the algal communities changed over last ~200 years?

Mann-Kendall trends – increasing or decreasing concentrations

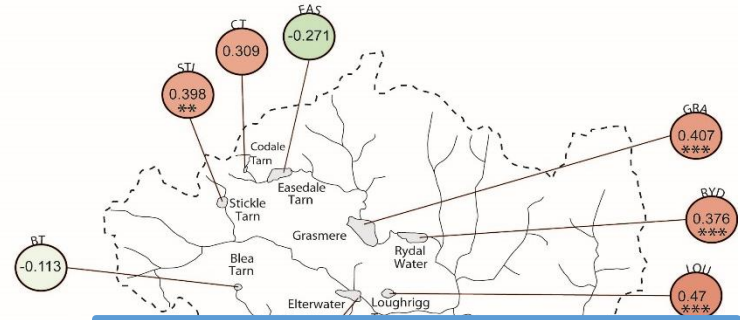


Increase in total production

Mann-kendall coefficient



β -carotene



Increase in colonial cyanobacteria

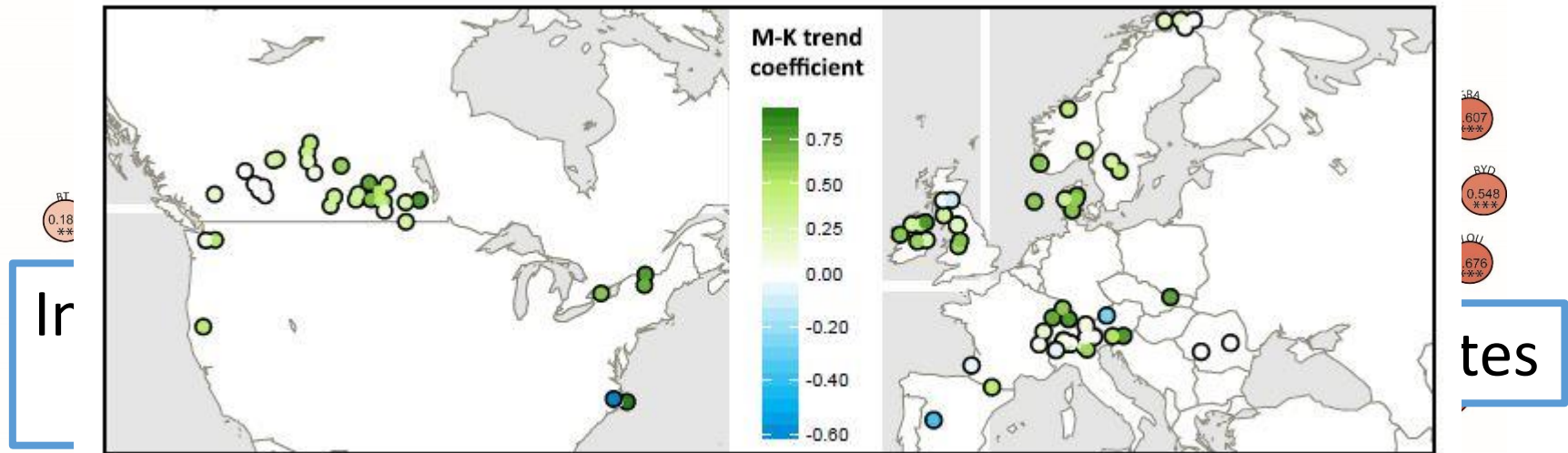
Mann-kendall coefficient



Canthaxanthin

How have the algal communities changed over last ~200 years?

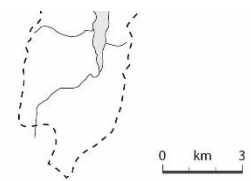
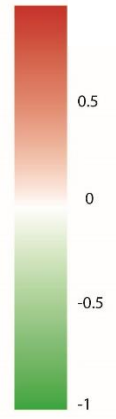
Mann-Kendall trends – increasing or decreasing concentrations



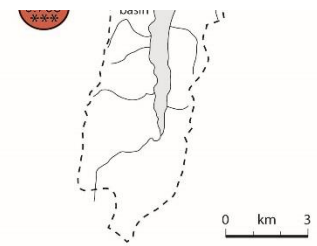
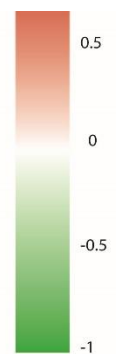
Mann-kend
coefficient

Myxoxanthophyll

Taken from Taranu *et al.* (2015). *Ecological letters*.



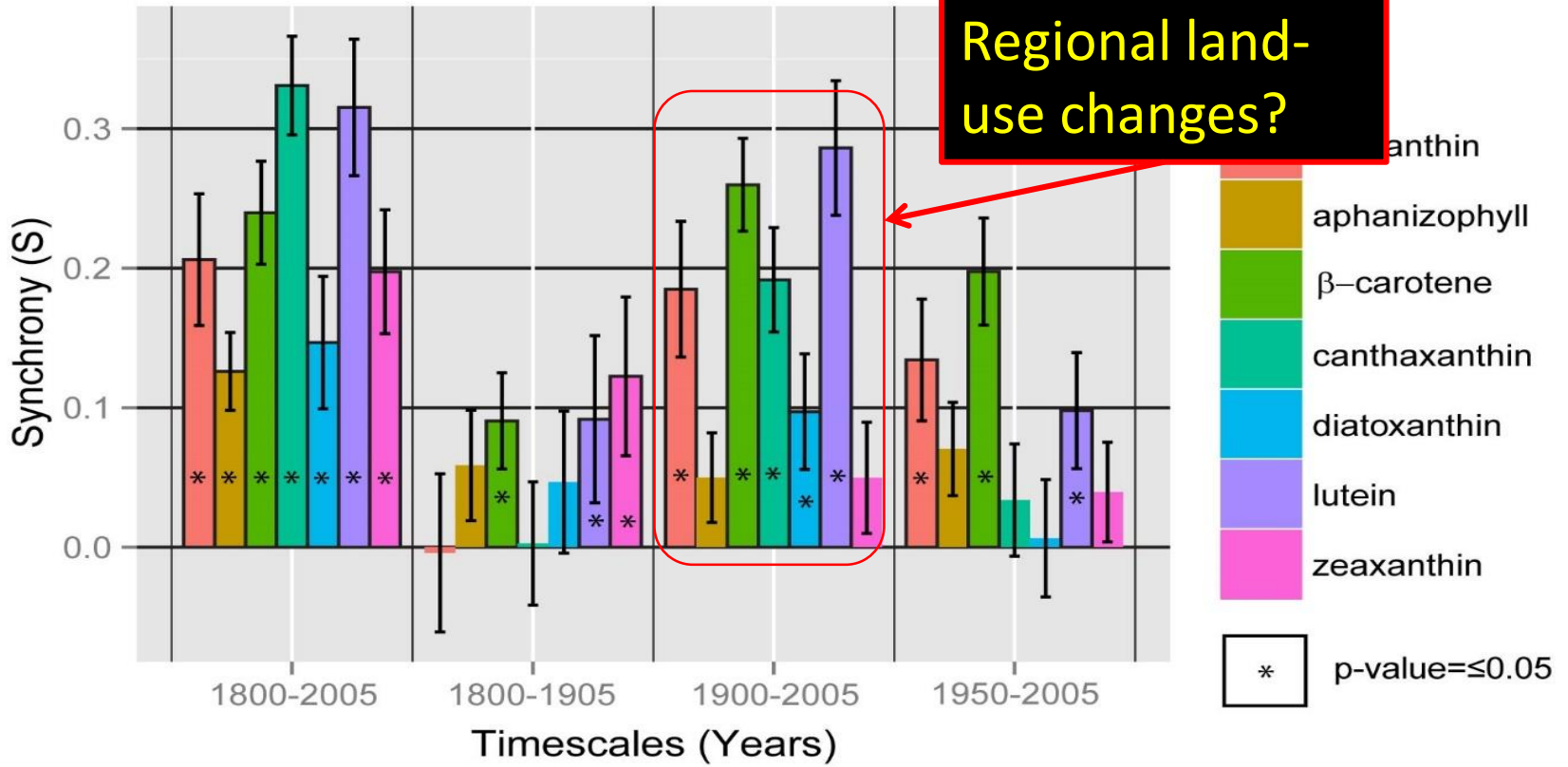
Aphanizophyll



Lutein

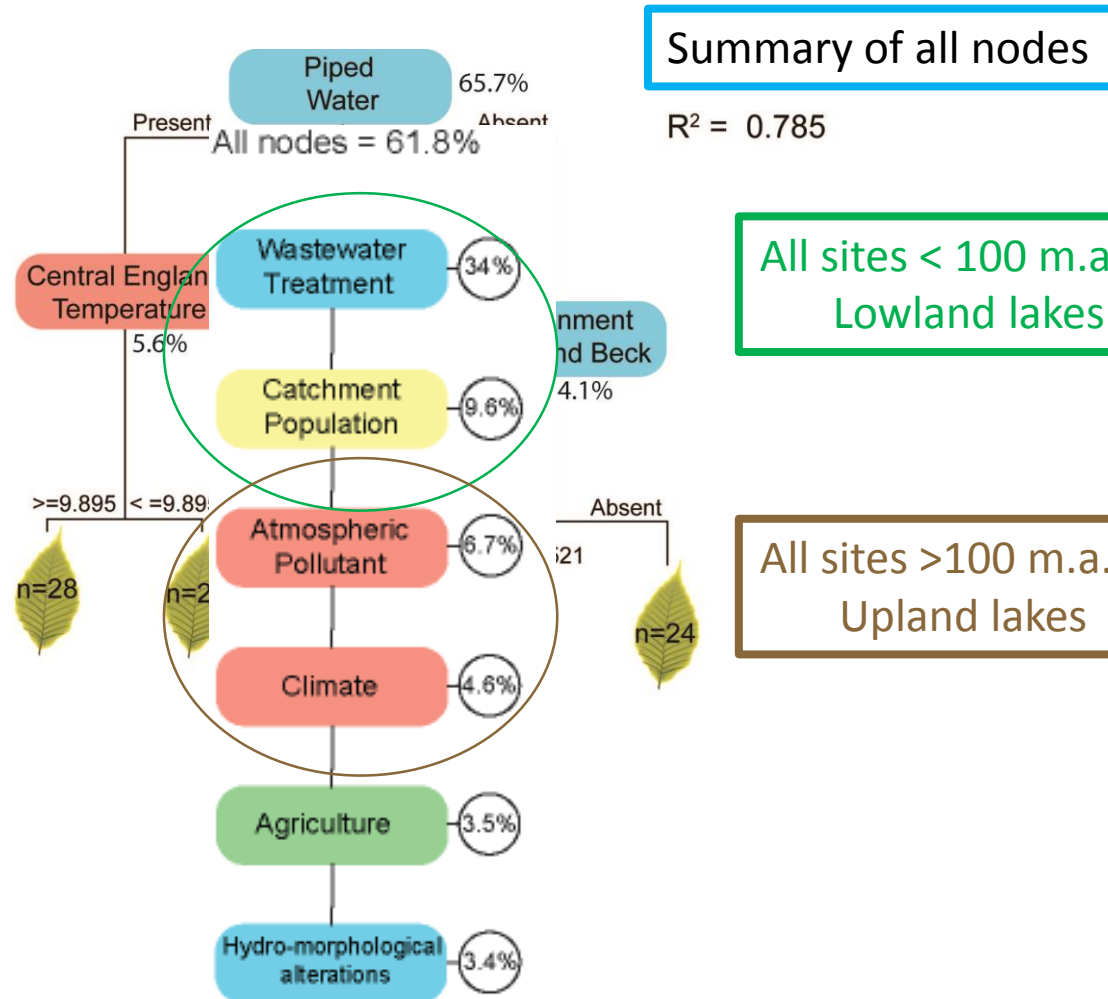
Is there a difference in algal community synchrony at different timescales?

20th century:
Higher synchrony:
Regional land-use changes?



What has caused the algal communities to change?

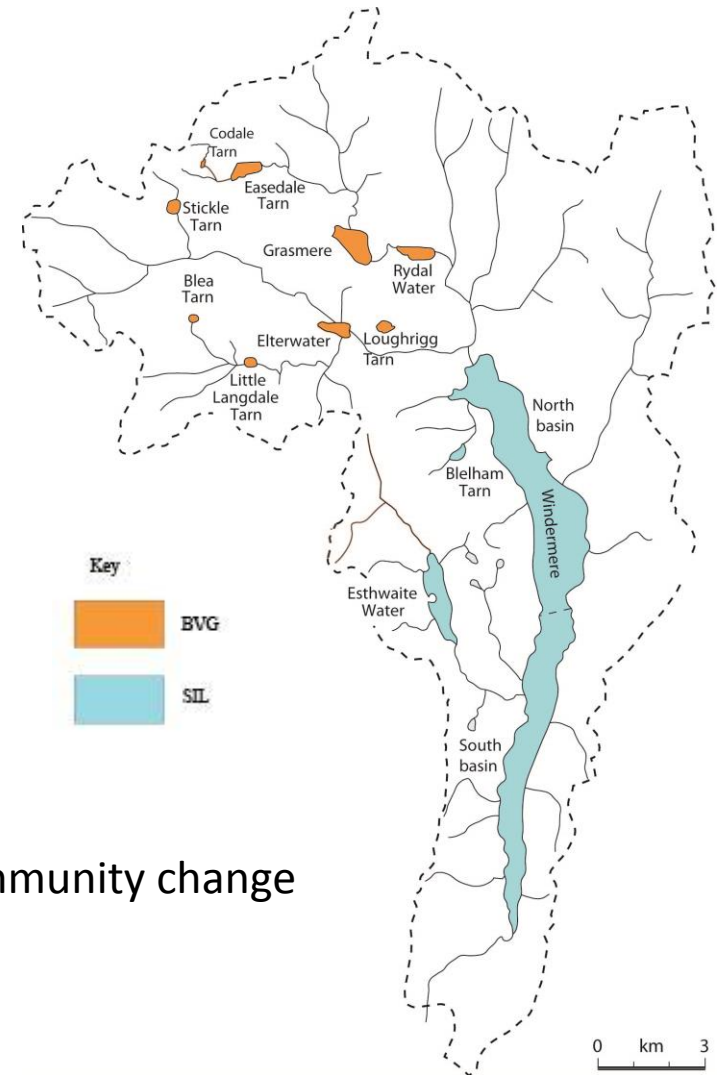
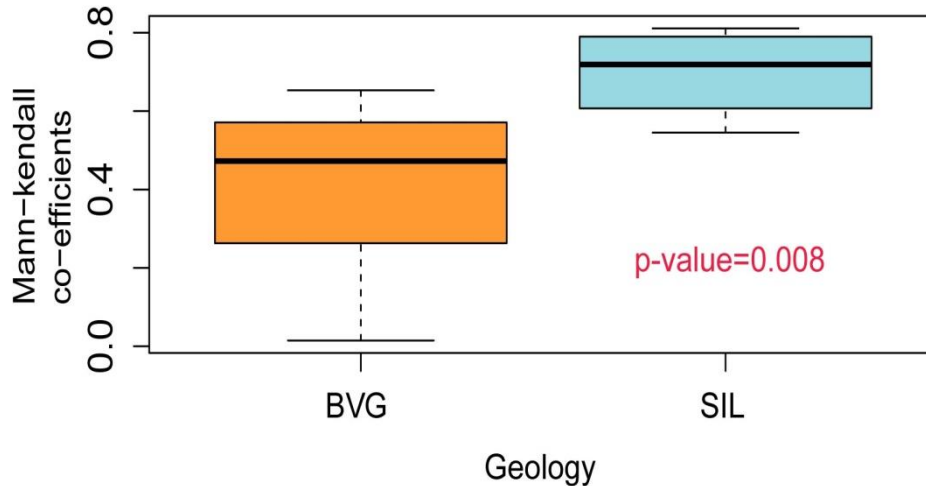
Multivariate regression trees – hierarchy of explanatory variables



Other factors attributing to algal community change?

Physical site and catchment characteristics

Geology

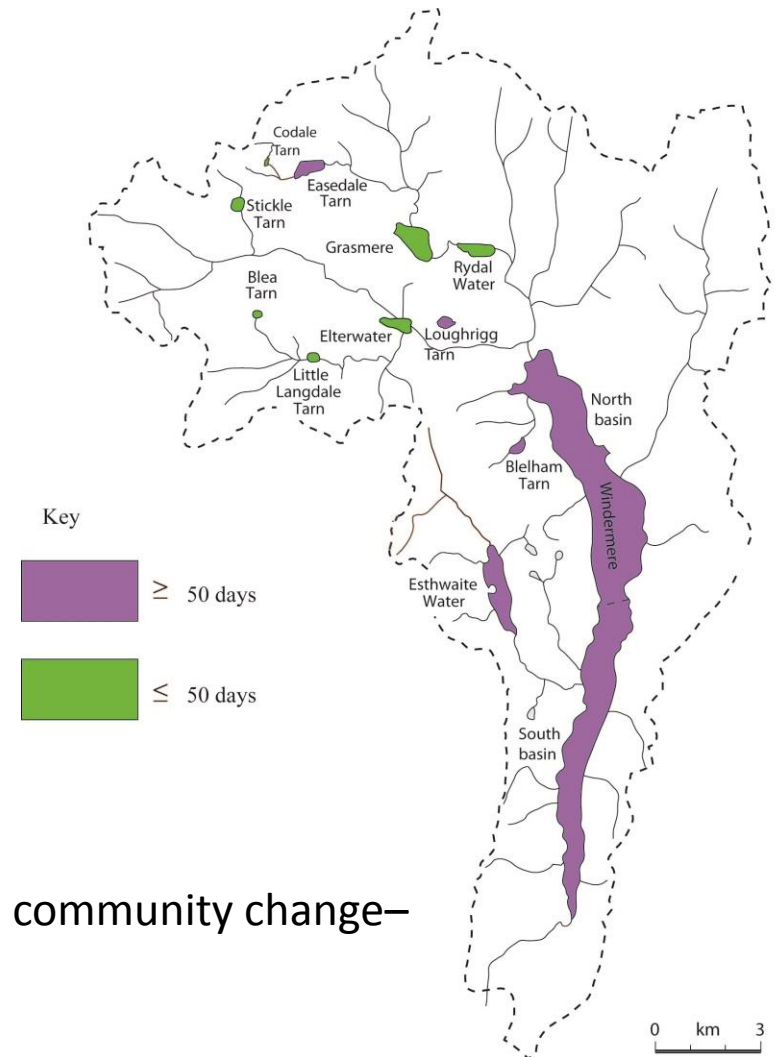
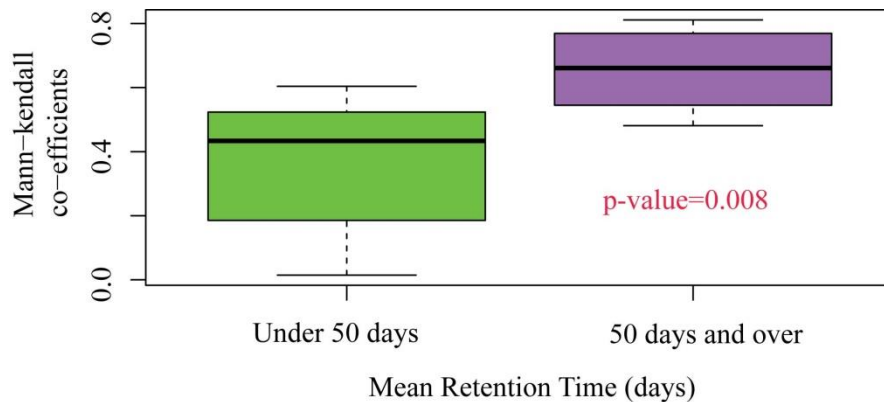


Naturally productive lakes – greater algal community change
– intensifying nutrient enrichment effects?

Other factors attributing to algal community change?

Physical site and catchment characteristics

Water Retention Time (WRT)



High water retention time (WRT) –higher algal community change–
concentration of nutrient enrichment effects?

Summary



- Increased algal production in all lowland lakes but not all upland
- Lakes less synchronous post-1950 (more point sources)
- Lakes with greatest algal community change found on sedimentary geology and have high WRT