

Determining the drivers of harmful algal blooms and their impact on public water supply resilience during droughts

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Project description

Water supply resilience is under increasing threat through a combination of predicted reductions in summer rainfall (IPCC) and changes in regulations that further restricts abstraction during low flows to protect downstream habitats. These restrictions will particularly affect reservoir management in pumped storage reservoirs. Changes in river abstraction will result in a reduction in reservoir depth in late summer at Llandegfedd Reservoir, South-east Wales, crucially timing changes in hydrology of the system when cyanobacterial blooms are favoured by environmental factors and nutrient dynamics (enhanced P supply and reduced N through summer denitrification). These blooms can produce toxins and metabolites that cause problems with water taste and odour, making it difficult to treat the water at times when alternative sources are unavailable. This highly interdisciplinary project will be a collaboration between three centres of excellence in water research (Cardiff, Bristol and Bath Universities) and Welsh Water who manage the reservoir. Work will entail significant amounts of field and lab work covering:-

1. Detailed analysis of physical parameters of the water body (depth, turbidity etc.)
2. Detailed analysis of the current circulation patterns and mixing characteristics of the reservoir
3. Detailed nutrient analysis of pumped input and diffuse catchment loadings (loading coefficients for N and P on an areal basis and variability over monthly and seasonal timescales)
4. Detailed nutrient analysis of Si, N fractions, full P fractions of reservoir waters in linear transects along both arms of the reservoir towards the dam
5. In situ nutrient addition mesocosm experiments
6. Ex situ sediment incubations to determine stimuli for enhanced internal loading (if relevant based on previous data)
7. Alkaline phosphatase activity (APA) analysis to verify potential P limitation

8.Sediment P fraction analysis with concomitant Fe, Al and Mn analysis

9.Mass balance analysis based on the above nutrient data to determine levels of internal loading (monthly time scale)

10.Algal counts and pigment analysis every 2 to 4 weeks between Feb and Nov to determine succession of community structure and linkage with nutrient turnover (e.g. is spring diatom productivity a nutrient feed for green algae in early summer and cyanobacteria in late summer?)

11.Productivity measurements of algae with concomitant physiological measurements of acclimation to environmental factors such as light (and hence linkage to turbidity)

12.Measurement of Geosmin and MIB cyanobacterial metabolite concentration

The overarching aim of the project is therefore to determine the factors controlling algal blooms within Llandegfedd Reservoir and linking these with algal community structure and magnitude and timing of harmful algal bloom products). The student will therefore work closely with Welsh Water and each supervisor.