

# Current diatom studies in South and Mid Wales

## Environmental assessments and rare species

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Diatom diversity and rare species

Diatom monitoring - River Usk

Diatom monitoring - River Wye

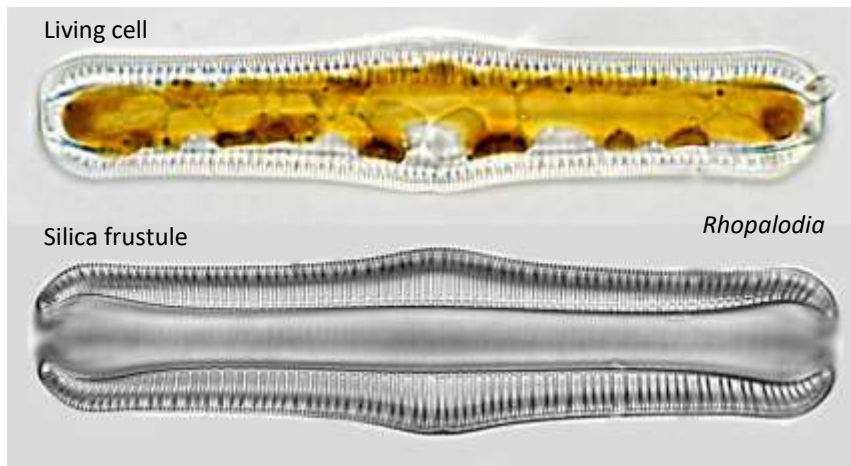
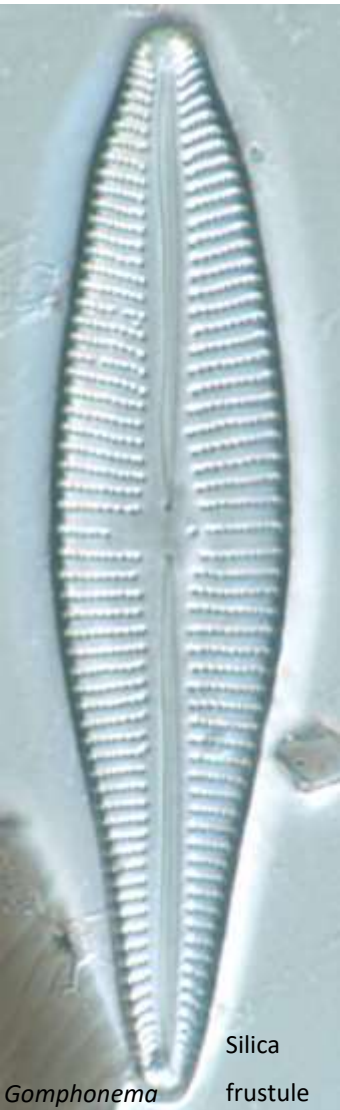


River Usk



Craig y Cilau

# Diatoms – microscopic algae with a cell wall made of silica



## Plankton

Floating

## Benthon

Free living or attached on

stones

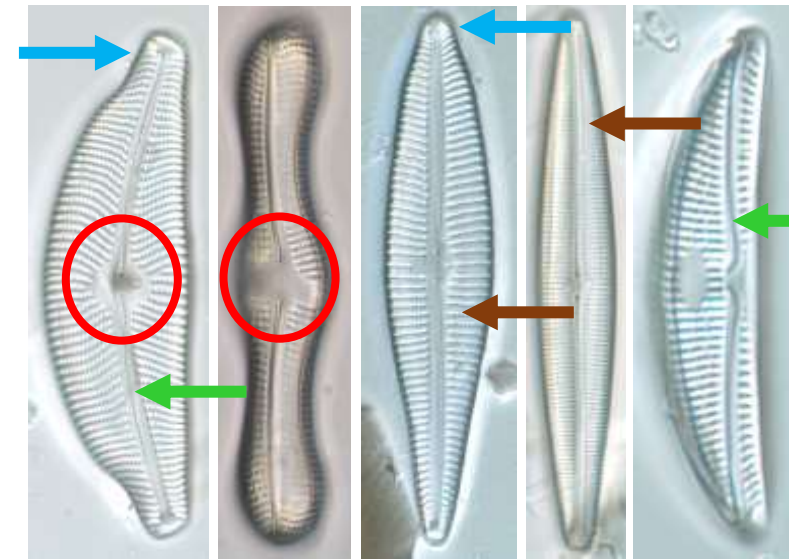
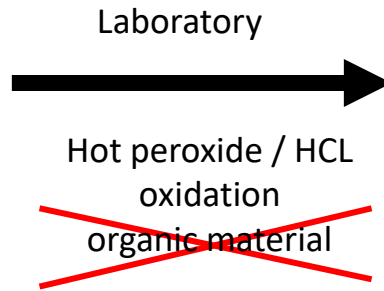
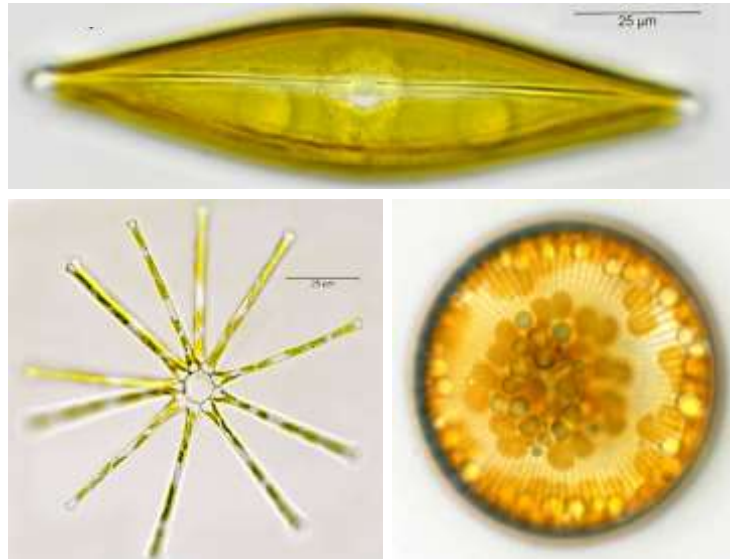
plants

sand

sediment



# Diatom sampling and processing



Shape Central area Poles Striae Raphe



Suspensions of diatom valves



Slides – light microscopy



Stubs – electron microscopy

## Diatom community analysis - taxonomic investigations

### Light microscope

Magnification x 1000

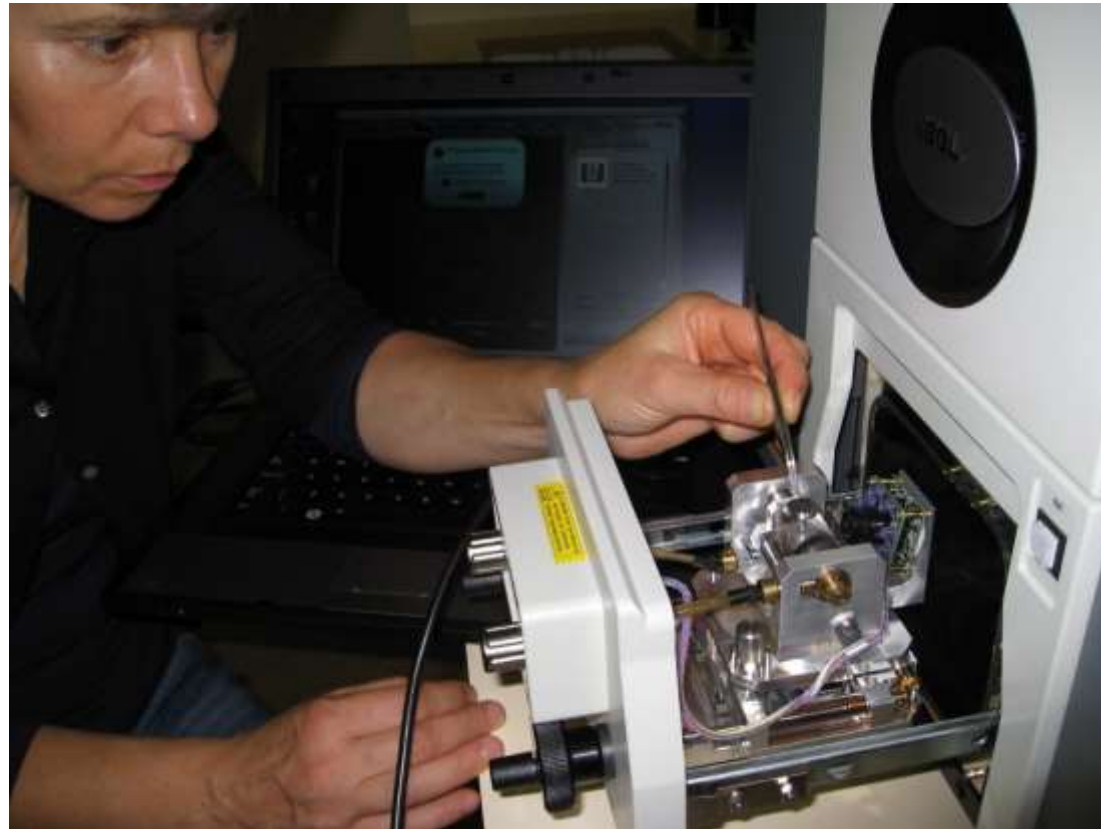
Identification, species composition



### Scanning electron microscope

Magnification > 1000 – 30000

Identification, cell wall structure



## Diatom collection at National Museum Cardiff



Diatom Database - National Museum Wales

Taxa   Samples   References   Updates   Glossary

Show All   Search   Add New Taxa   Delete Taxa

Taxon - ID 2653   Publish to Web   Unpublish   Published

*Gomphonema varioreduncum* Jüttner, Ector, Reichardt, Van de Vijver & Cox; 2013; 4

Bacillariophyceae: Bacillariophycidae: Cymbelales: Gomphonemataceae

Status: Verified / Unverified

Classification   Morphology   Biology   Ecology   Literature   Maps   Images   Collections   Curation   Publishing

LM Morphology   SEM Morphology   Description (old DB)

Shape   Symmetry & Size   Valve   Striae   Axial & Central   Raphe   Other   Notes

**Shape**

Valve view 1  isopolar  heteropolar

Valve view 2

elliptical  
 narrowly elliptical  
 broadly elliptical  
 elliptic-lanceolate  
 lanceolate  
 broadly lanceolate  
 narrowly lanceolate/usiform  
 acicular (very narrowly lanceolate)  
 rhombic  
 narrowly rhombic  
 linear  
 narrowly linear  
 broadly linear  
 linear with gibbous centre  
 linear-lanceolate  
 narrowly linear-lanceolate  
 broadly linear-lanceolate  
 rectangular  
 subcircular  
 circular  
 panduriform (constricted)  
 sigmoid linear  
 sigmoid lanceolate  
 sigmoid rhombic  
 trapezoidal

triangular  
 trilinear  
 cruciform  
 quadrate  
 pentagonal  
 polygonal  
 ovate  
 narrowly ovate  
 broadly ovate  
 apiculate  
 clavate  
 bilobate  
 hastate  
 cymbeloid  
 semicircular  
 crescentic  
 arcuate  
 auricular  
 reniform

Girdle view 1  isopolar  heteropolar

Girdle view 2

linear    square    clavate    biconvex  
 rectangular    arcuate    sigmoid

Poles (Valve)

broadly rounded  
 cuneate  
 rostrate  
 subrostrate  
 capitate  
 subcapitate  
 apiculate  
 apiculate produced  
 acute  
 spatulate

Poles (Girdle)

Rostra (beak-like)  
 deflected  
 deflected dorsally  
 deflected ventrally

Web Shape description

Clavate, narrow lanceolate, often slightly cymbeloid with head pole and/or foot pole often deflected.

Modification: Jüttner, 23/11/2016 12:37:01

Commit Record

Filemaker database

&gt; 7170 diatom samples

&gt; 1500 diatom species

&gt; 2170 literature references



## *Planothidium*, *Reimeria*, *Skabitschewskia*, *Staurosirella*



This spring at Waun Ddu bog, Craig y Cilau, has a very diverse diatom flora including many rare species

Van de Vijver B., Kusber W.-H., Jüttner I. et al. Revision of the *Staurosirella leptostauron* complex .. in Europe with the description of three new species. Submitted to Plant Ecology and Evolution.

*Planothidium dubium*

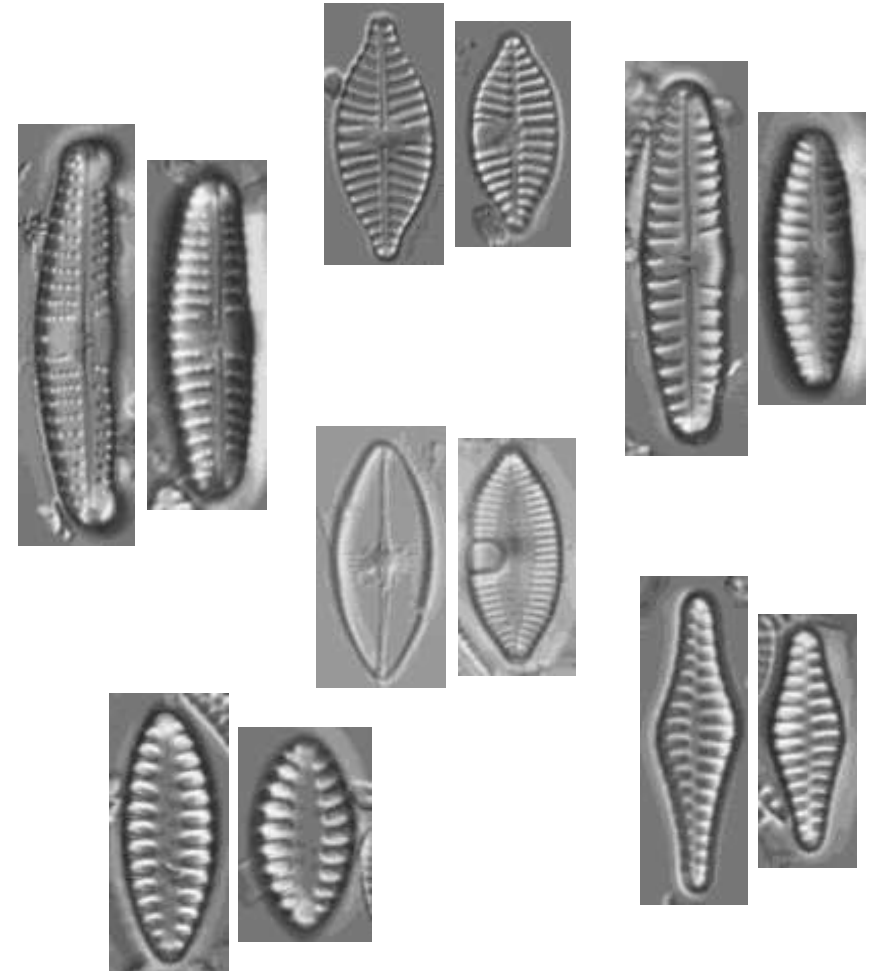
*Reimeria ovata*

*Reimeria uniseriata*

*Skabitschewskia oestrupii*

*Staurosirella neorhomboides*

*Staurosirella subrobusta*



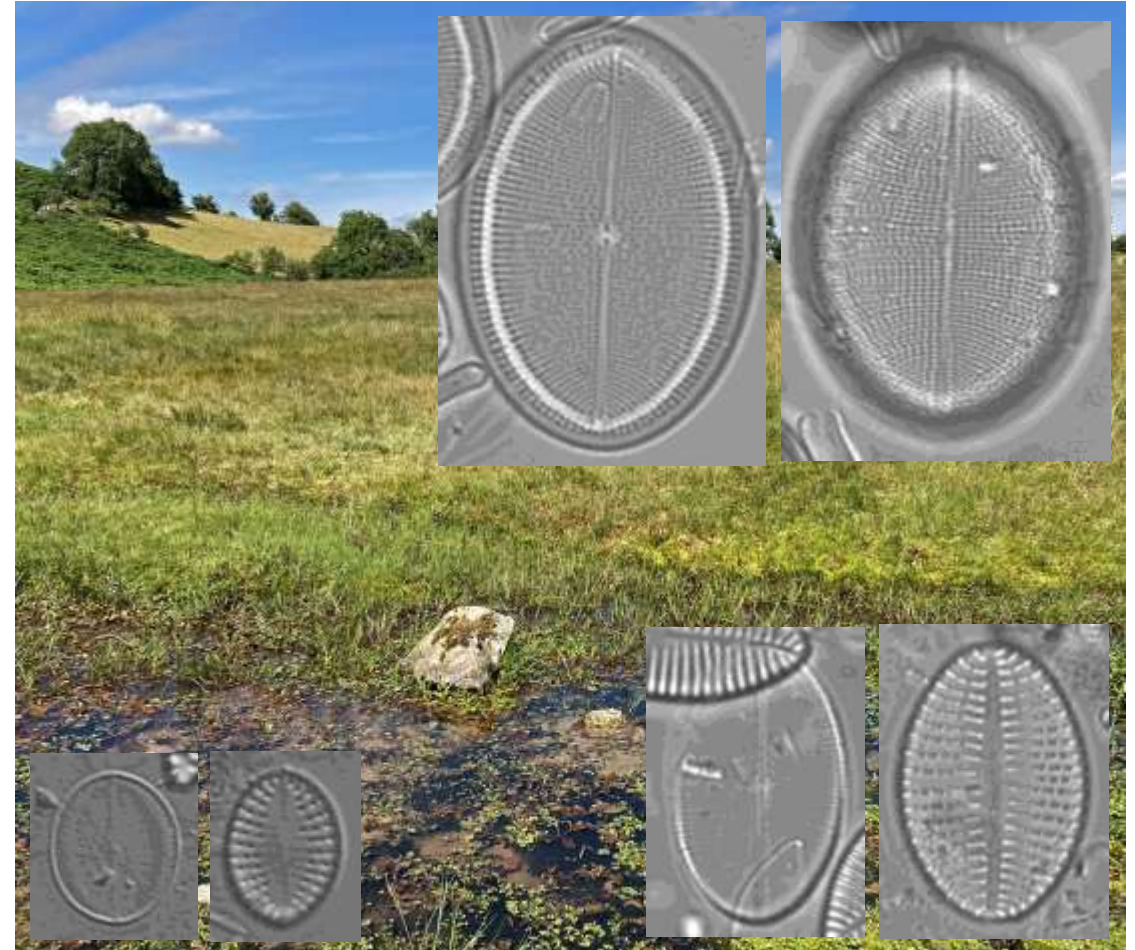
# Cocconeis

Kenfig Pool



*Cocconeis neothumensis*

Craig y Cilau – spring at Waun Ddu bog



*Cocconeis pseudothumensis*

*Cocconeis placentula* var. *klinoraphis*

*Cocconeis disculus*

Four rare *Cocconeis* species found in South Wales

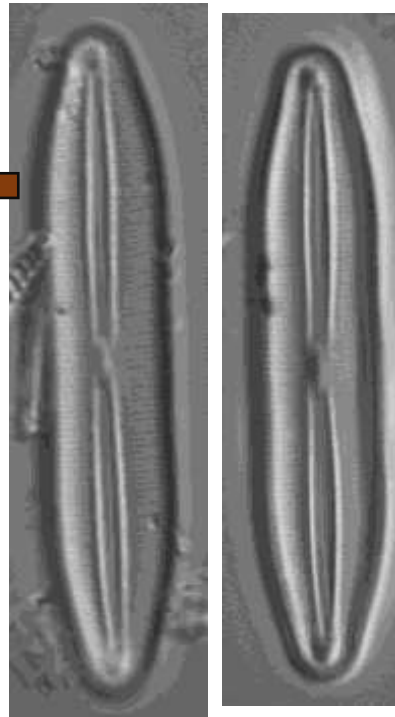
## Berkella, Frustulia

Sgwd yr Eira

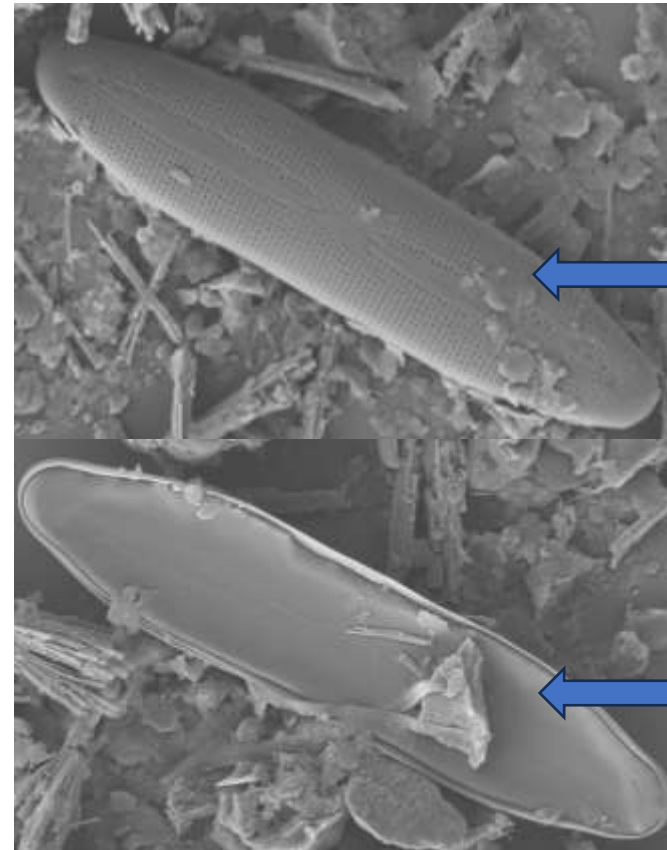


Jüttner et al. 2023. A review of some species of *Berkella* and *Frustulia* occurring in freshwaters of Britain and Ireland with documentation of the types of *Berkella linearis*, *B. alpina*, *Frustulia saxonica* and *F. crassinervia*. Nova Hedwigia 117, 319-350.

*Berkella linearis*



Grows on mosses behind waterfall

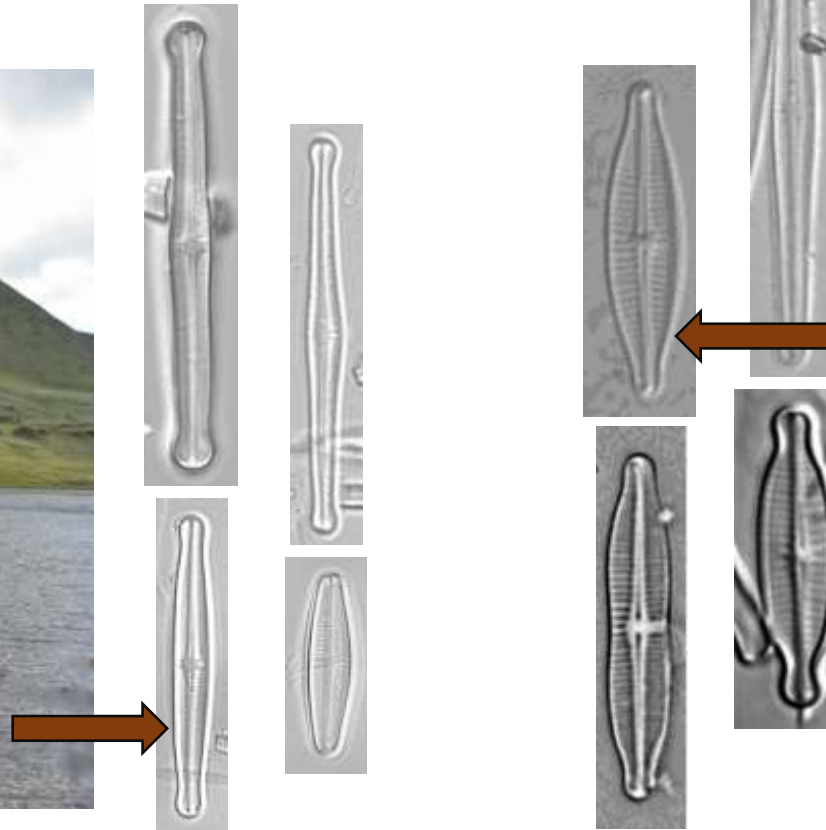


'Normal' valve surface  
with perforations

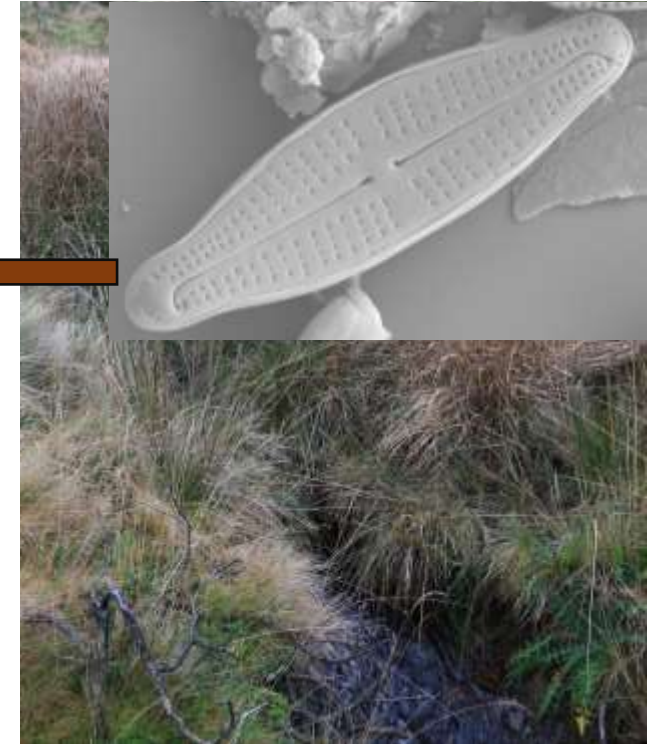
Additional solid silica sheet  
on valve surface might protect  
the cell from desiccation  
in habitats which can dry out

# Achnanthydium

*Achnanthydium sieminskae*, a common species at Llyn y Fan Fawr

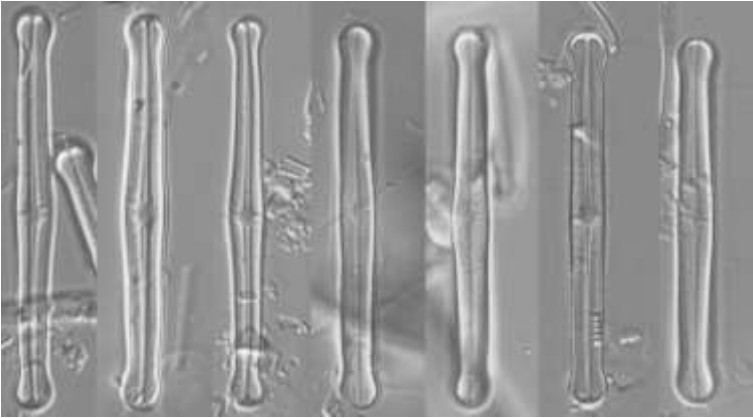


*Achnanthydium rostroyrenaicum*, a rare species found in a stream on Mynydd Epynt



Jüttner et al. 2022. A study of the morphology and distribution of four *Achnanthydium* species .., implications for ecological status assessment .. Cryptogamie, Algologie 43, 147-176.

Jüttner et al. 2023. Investigation of the type material of *Microneis gracillima*, *Navicula pyrenaica*, *Achnanthes amphicephala*, *Achnanthes thienemannii* and *Achnanthydium rostroyrenaicum* ... Fottea 23, 122-140.

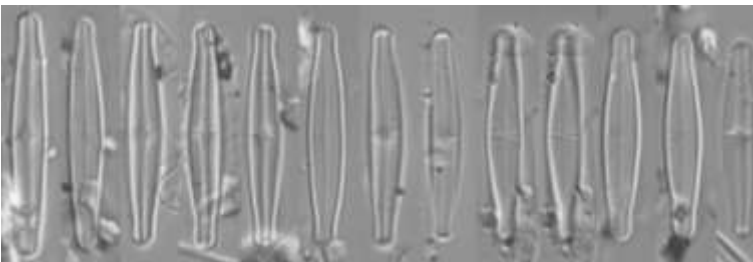


*Achnanthydium caledonicum*  
Lochan na Ba Ruaidhe, Scotland

**Indicator of high ecological status**



*Achnanthydium neomicrocephalum*  
Loch Tarff, Scotland



*Achnanthydium sieminskae*  
Llyn y Fan Fawr, Wales



*Achnanthydium minutissimum*  
Savoich, Scotland



Recorded in diatom index as  
**'*Achnanthydium minutissimum* type'**

**Are these three species indicating the same  
environmental conditions: good ecological status ??**

The distribution of *Achnantheidium minutissimum*, *A. caledonicum*, *A. sieminskae* and *A. neomicrocephalum* was studied in 52 diatom samples from Scotland in relation to land use.

The diatom communities were divided into two groups, and were found either in locations with agriculture, improved grassland or urban areas, sites with pollution tolerant species, or in seminatural areas with unimproved grassland, moorland, marshes, heaths or mountains, sites with pollution sensitive species.

*Achnantheidium minutissimum* was more abundant in locations with pollution, while *A. caledonicum*, *A. sieminskae* and *A. neomicrocephalum* were found only in locations with low human impact.

This indicates that *A. minutissimum*, *A. sieminskae* and *A. neomicrocephalum* do not occur in the same environmental conditions and should not be recorded under the same name ('*A. minutissimum* type' indicating good water quality) as they are currently in the diatom index. They should be recorded as distinct species with different tolerances to pollution.

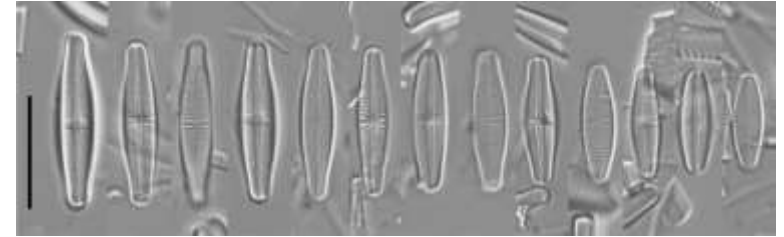
There are other species similar to *A. minutissimum* which would be recorded as '*A. minutissimum* type' but are tolerant of metal pollution, such as a taxon found at the former lead and zinc mine Esgair Mwyn in Ceredigion. The population was found in a small stream that did not have good water quality but was strongly polluted with cadmium and zinc.

For further information see: [Jüttner et al. 2022. A study of the morphology and distribution of four \*Achnantheidium\* Kütz. species \(Bacillariophyta\), implications for ecological status assessment, and description of two new European species. \*Cryptogamie, Algologie\* 43, 147-176, Fig. 21.](#)

Esgair Mwyn mine, Ceredigion



*Achnanthydium minutissimum*



*Achnanthydium* sp.

High concentrations of cadmium and zinc





River Usk E of Sennybridge



River Usk N of Newport

## River Usk – water quality monitoring



## River Usk – water quality monitoring

Rafia Abdul-Majid Hadi 1981. Algal Studies of the River Usk.

PhD thesis: University College, Cardiff

Resurvey of sites studied monthly for diatoms 6/1979 – 7/1980

Summer: July 2022

Spring: May 2023

Autumn: October 2023

Investigation of

- diatoms
- water chemistry

pH, conductivity, alkalinity, Ca-hardness

Mg, Cl, NO<sub>3</sub>, PO<sub>4</sub>, SO<sub>4</sub>, temperature

## River Wye – water quality monitoring



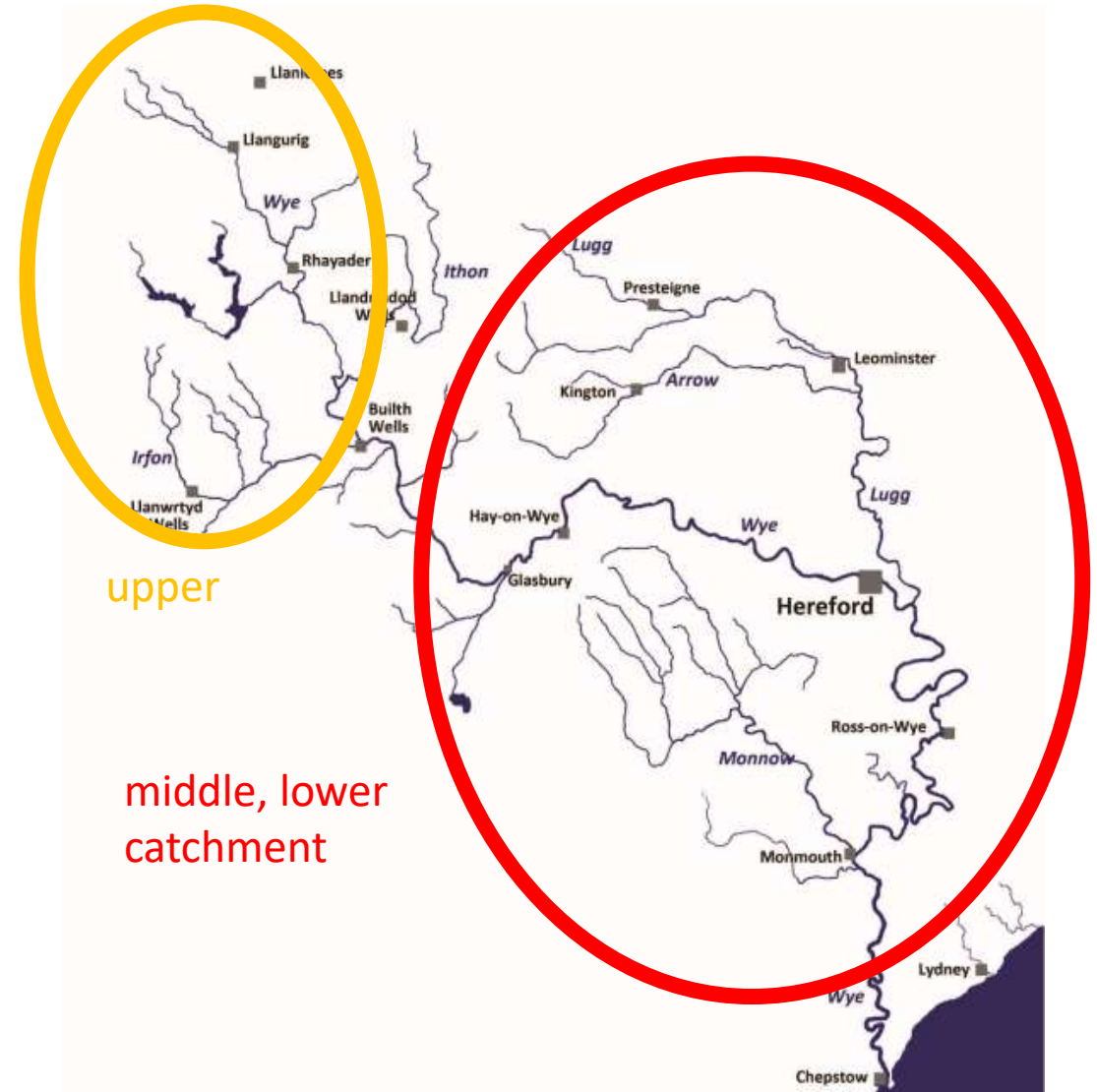
Acidification

2003-2008  
2011-2013



Eutrophication

2003-2024



## River Wye – acidification

### PHISH – Powys Habitat Improvement Scheme

### ISAC – Irfon Special Area of Conservation

Funding: Natural Resources Wales, Welsh Government, EU LIFE+ Nature programme to enhance Natura 2000 sites

Amgueddfa Cymru: diatom monitoring, water chemistry

Wye and Usk Foundation: liming and fish monitoring

Bowburn Consultancy: DAM – acidification index

Rough upland grassland



Conifer plantations



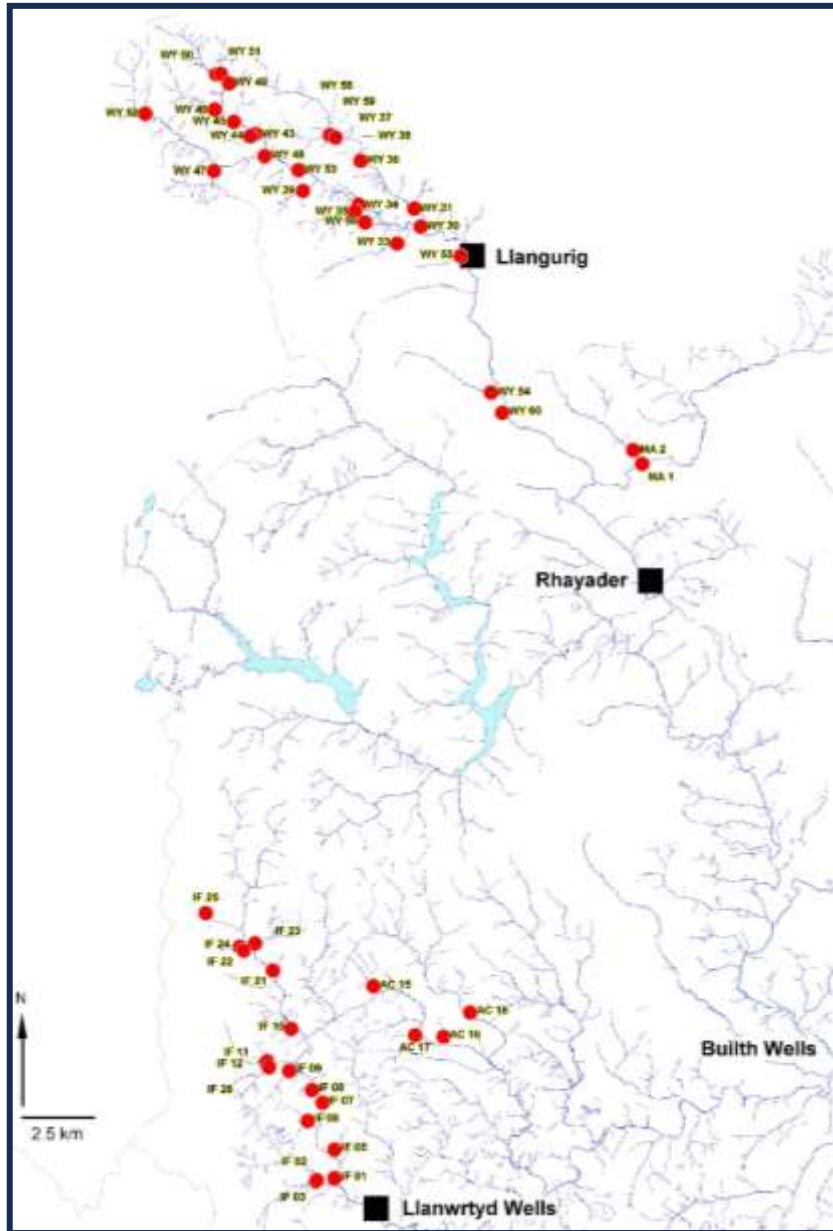
#### Change in land use and stream chemistry

- low pH
- high aluminium

#### Loss of biodiversity

- salmonid fish
- macroinvertebrates
- acid sensitive diatoms





Bedrock geology with low buffer capacity

Acid soils

Objectives

Reduce acidity through liming

Restore biodiversity

- salmonid fish
- macroinvertebrates
- diatoms

Monitoring

2-4 surveys per year

PHISH 2003-2008 47 sites

ISAC 2011-2013 22 sites

Hydrological source liming



Sand liming



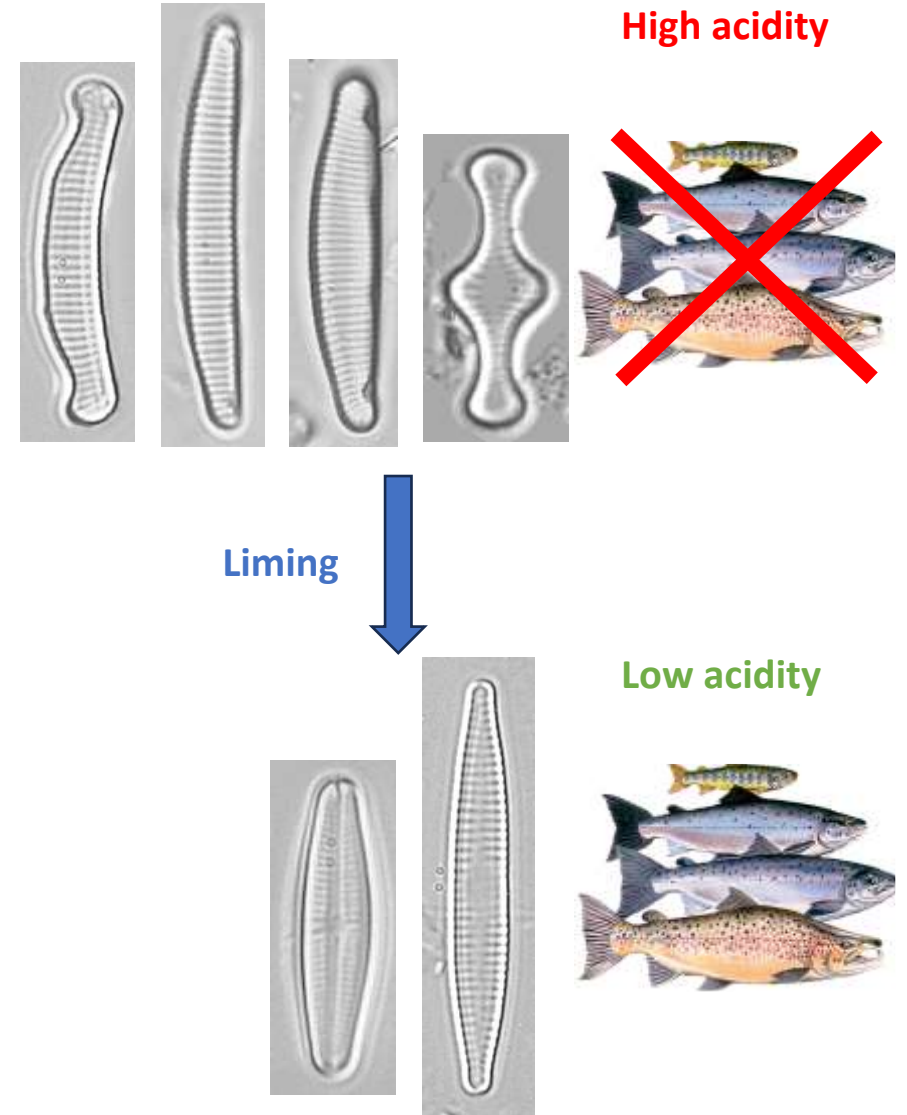
## River Wye – recovery from acidification after liming

During the PHISH and ISAC projects stream acidity was monitored using diatoms before and after liming to assess the effectiveness of the treatment.

Before liming species tolerant of low pH including *Eunotia exigua*, *E. subarcuatoides*, *E. incisa* and *Tabellaria flocculosa* were dominant in the acidified streams.

After liming acid-tolerant species became less abundant and were replaced by acid-sensitive species, predominantly *Achnanthydium minutissimum* and *Fragilaria gracilis*.

After liming increasing number of salmon corresponded to changes in diatom community composition.



# River Irfon subcatchment – recovery from acidification after liming

Increase in pH

Acid sensitive diatoms dominant

Improvement in ecological status

Increase in juvenile salmon

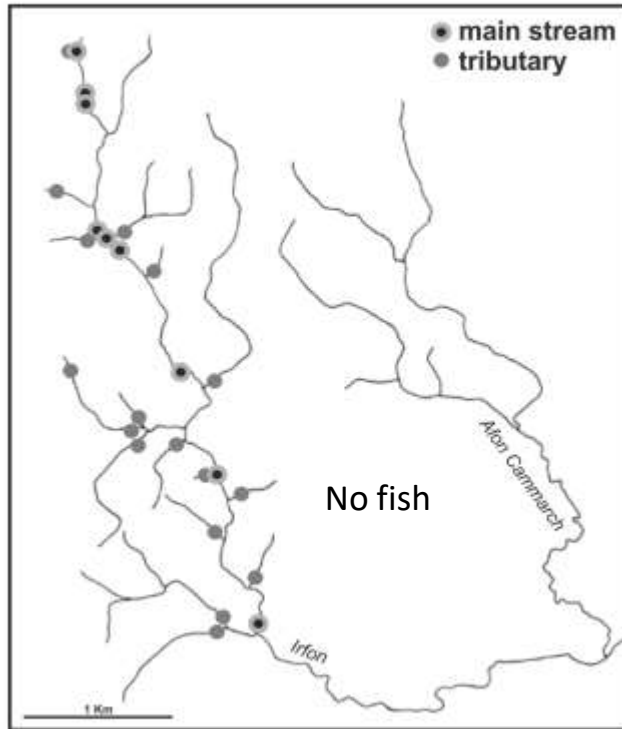
Liming continues annually

Repeat of diatom surveys 2024, 2025

## Ecological status class of streams

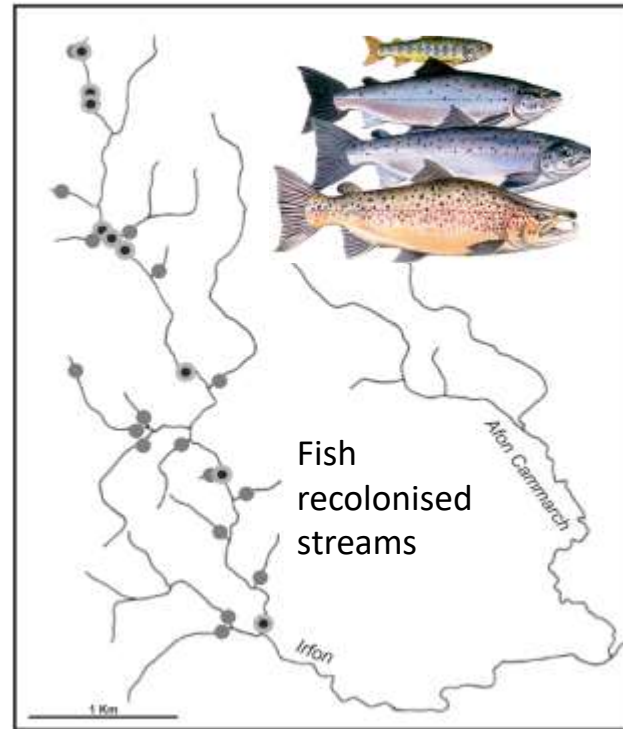
Upper catchment sites: moderate  
Lower catchment sites: good / moderate

Upper catchment most sites: good / high  
Lower catchment all sites: high



2003

Liming



2013

For further information see:  
Jüttner I., Kelly M.G., Evans S., Probert H., Orange A., Ector L., Marsh-Smith S. 2020. Assessing the impact of land use and liming on stream quality, diatom assemblages and juvenile salmon in Wales, United Kingdom. *Ecological Indicators* 121, 107057 (open access), Figs 6-12.

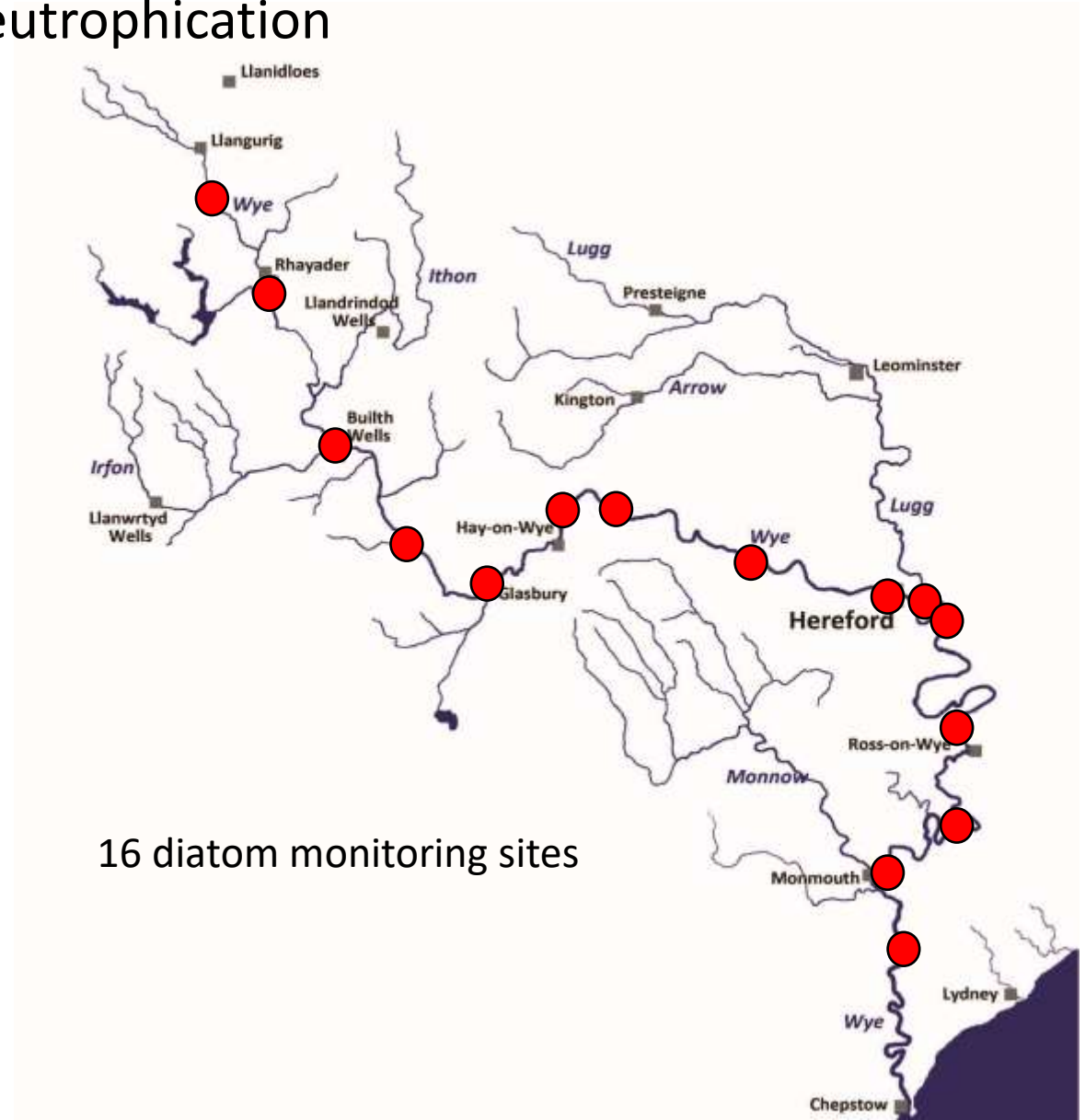
## River Wye – eutrophication

River Wye at Erwood

2023



2022



16 diatom monitoring sites

# River Wye – eutrophication

## Diatom dataset

2003 – 2005	M.G. Kelly / EA	Diatoms
2014	I. Jüttner	Diatoms
2018	I. Jüttner	Diatoms
2022 (drought)	I. Jüttner	Diatoms
2023 (flood)	I. Jüttner	Diatoms, water chemistry
2024	I. Jüttner	Diatoms, water chemistry

## Diatom Flora of the River Wye

### Long-term change of ecological status

