



Cumbria- an internationally important region for long-term lake research

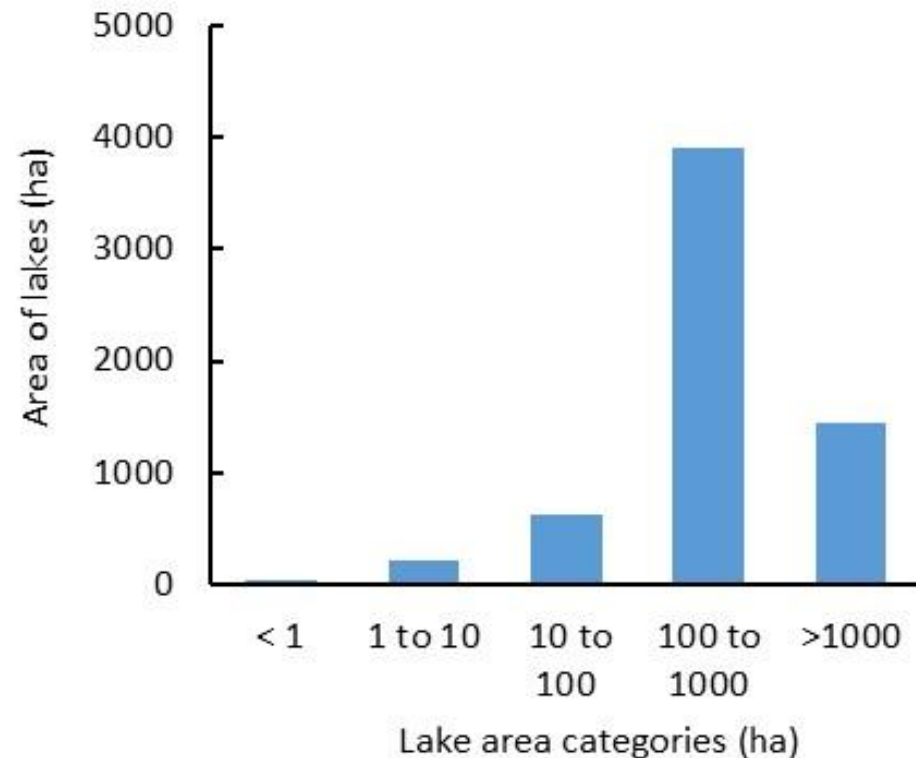
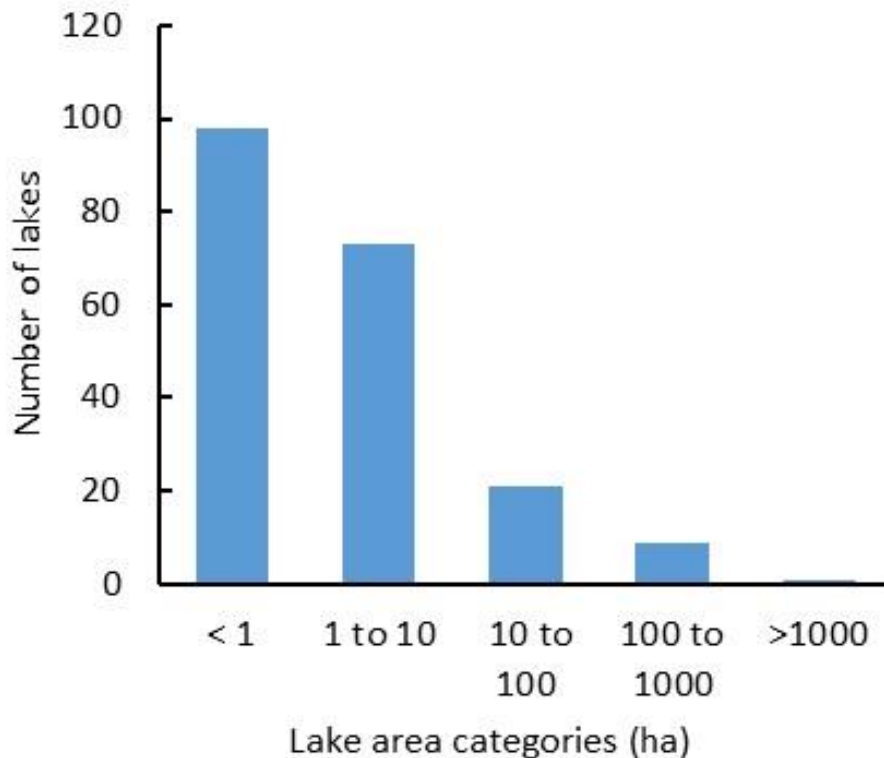
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Cumbria and the English Lake District

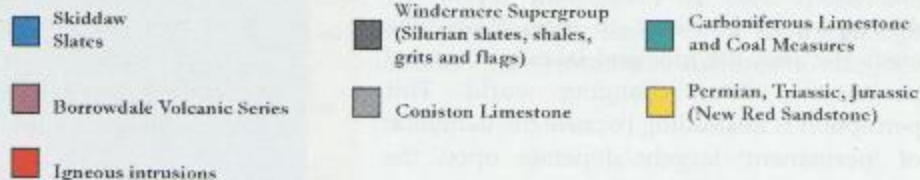
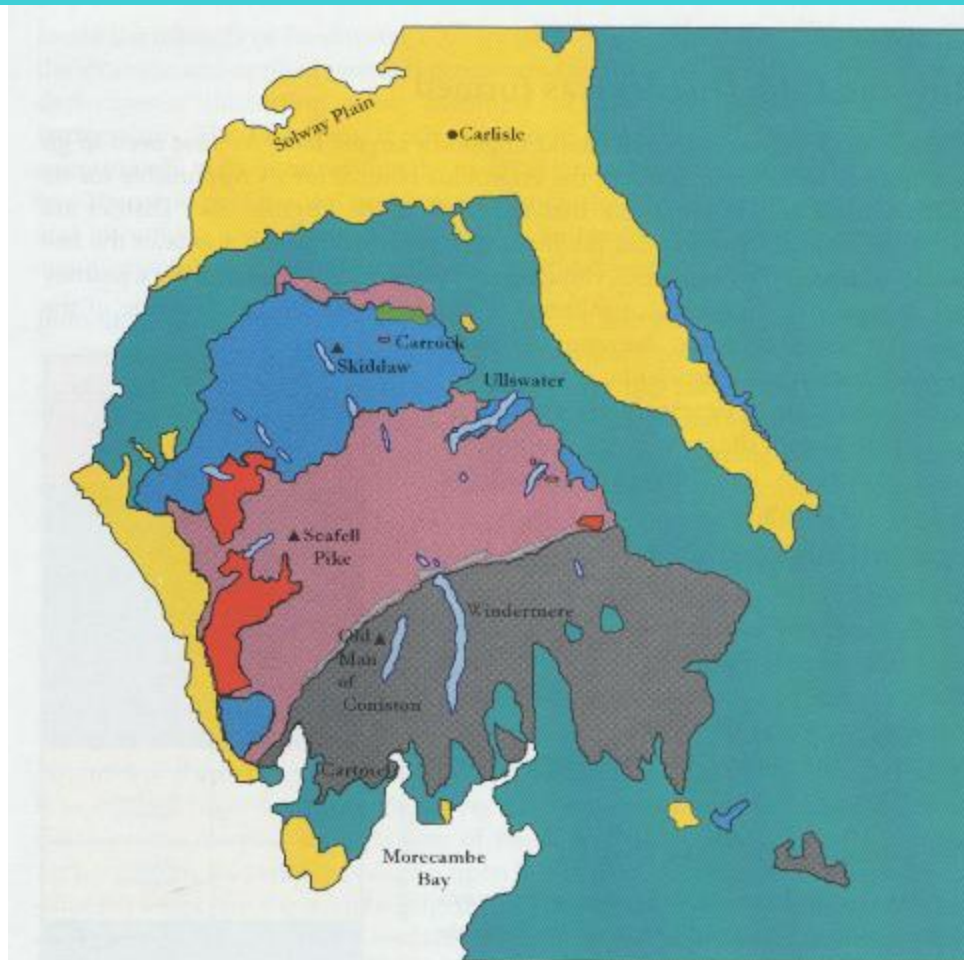


Some geography...

- 202 Lake District lakes (i.e. in LDNP) in UK Lakes database (i.e. greater than 0.1 ha)
- Total area 6240 ha (62.4 km²)

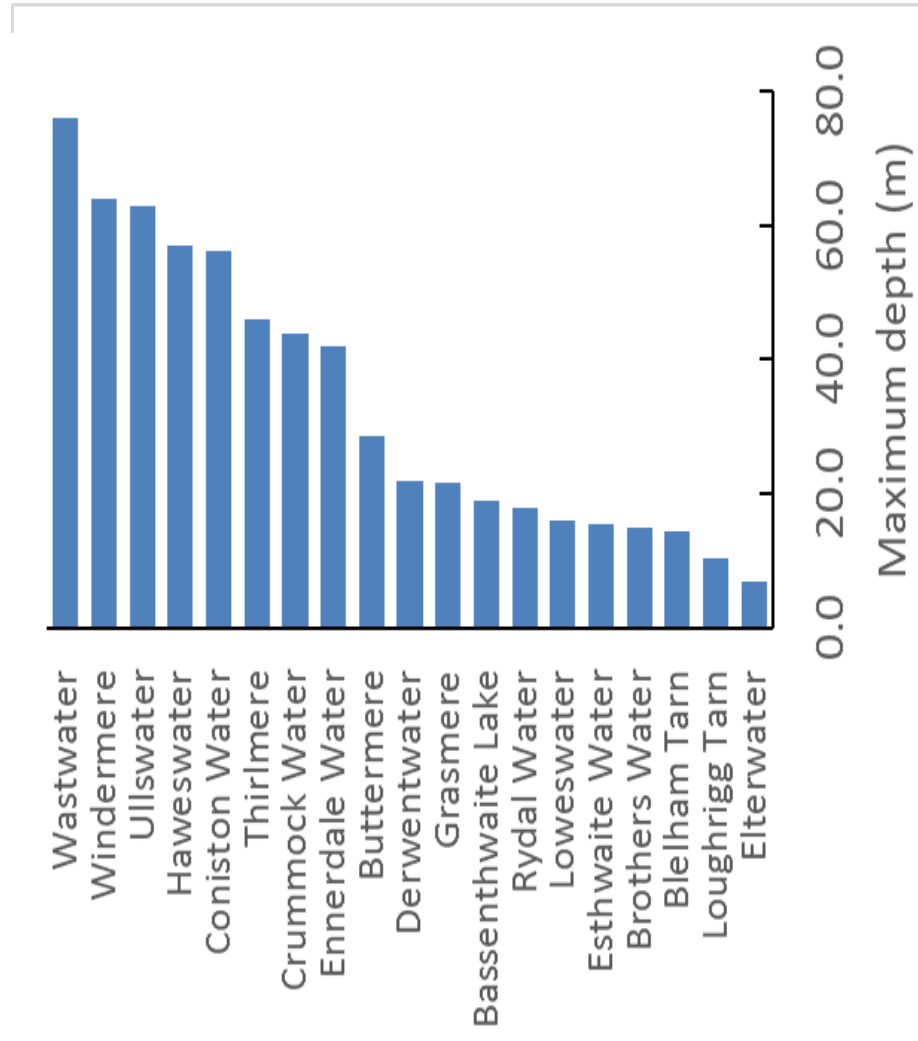
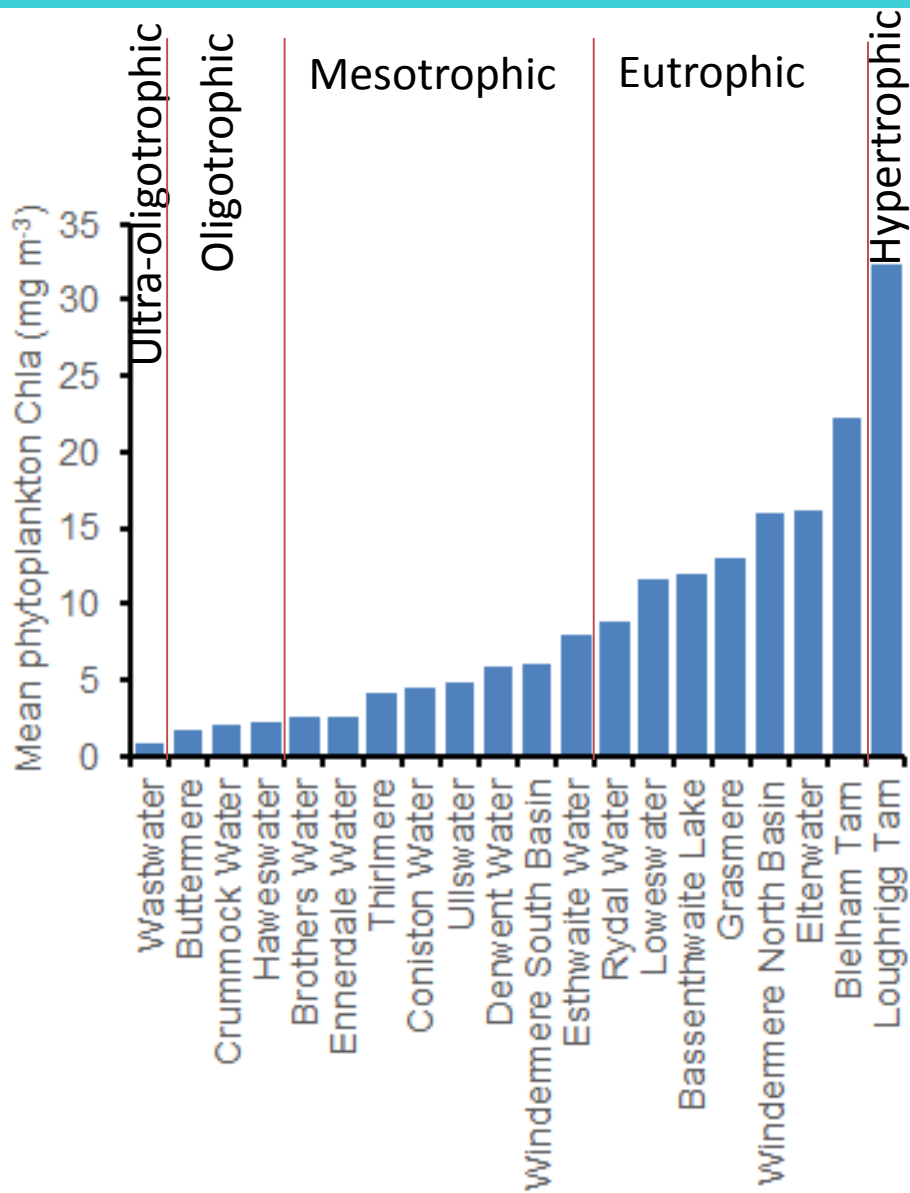


Diverse geology & diverse lakes



Pickering (2001)
Windermere:
Restoring the Health
of England's Largest
Lake
Published by FBA

Deep/shallow, Oligo/hypertrophic



Some history...



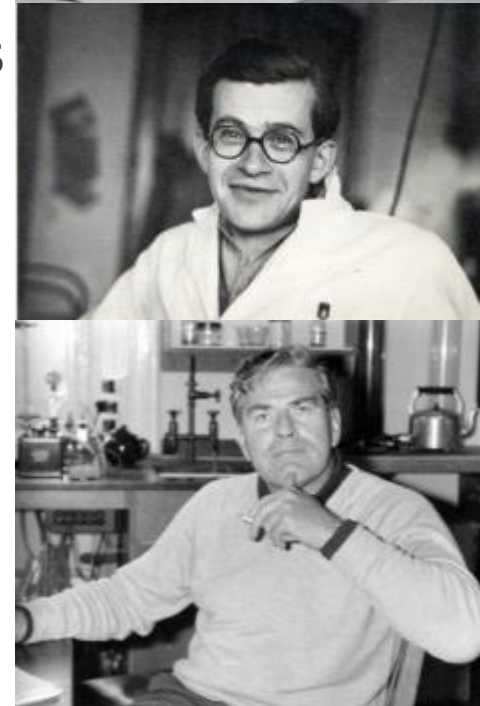
Standing on the shoulders of giants...

- From the 1930s the FBA built up expertise on fish, zooplankton, phytoplankton, chemistry, sediments and paleolimnology and lake physics
- They were led by some exceptionally talented, successful and influential scientists

Geoffrey Fryer FRS



John Lund FRS



John Mackereth



Jack Talling FRS



Winifred Pennington FRS



Clifford Mortimer FRS



TT Macan

CEH's long-term research in the English Lake District



North Basin
Windermere (1943)



Blelham Tarn (1945)



Derwent Water (1990)



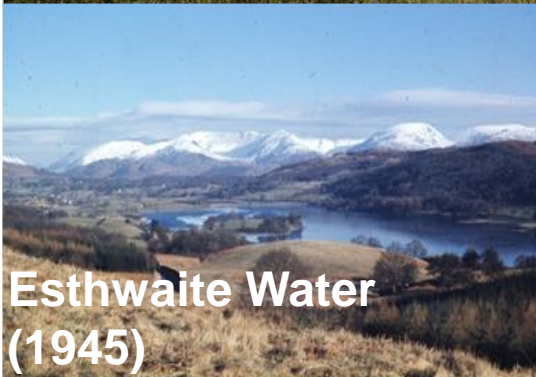
South Basin
Windermere (1943)



Grasmere (1970)



Bassenthwaite Lake
(1990)



Esthwaite Water
(1945)

Freshwater Biology (2012) Special Issue 57(2).
Ed. S.C. Maberly & J.A. Elliott

Long-term research

- Fortnightly measurements of temperature & oxygen profiles, Secchi depth, water chemistry, phytoplankton composition and chlorophyll a, zooplankton
- Seasonal fish surveys (Windermere, Bassenthwaite Lake & Derwent Water)
- Monthly day/night hydroacoustic survey (Windermere)



Janice Fletcher



Mitzi de Ville



Ellie Mackay



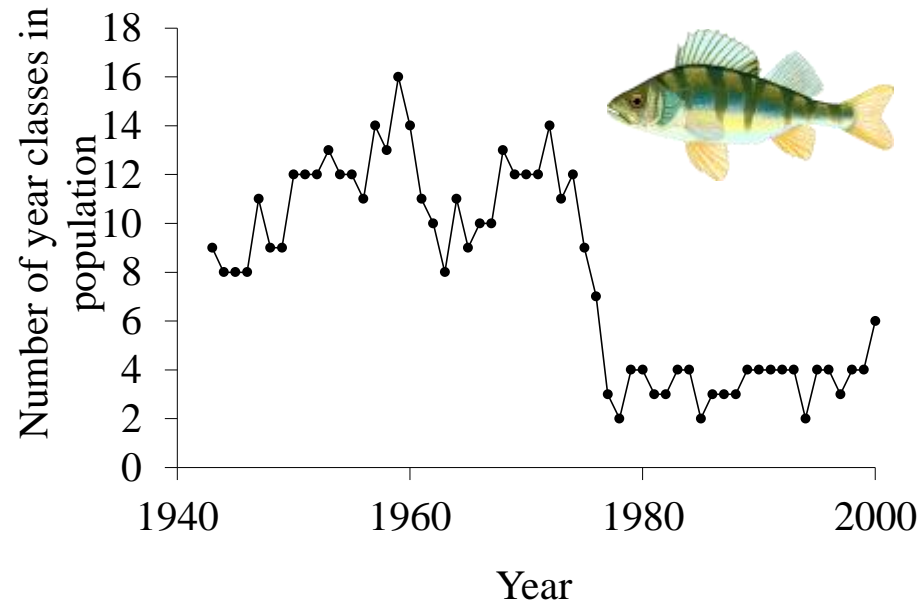
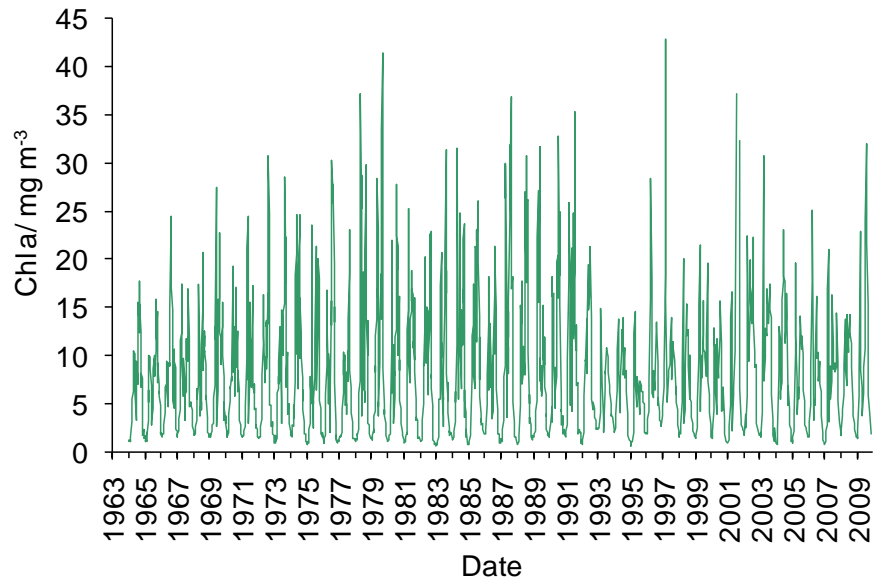
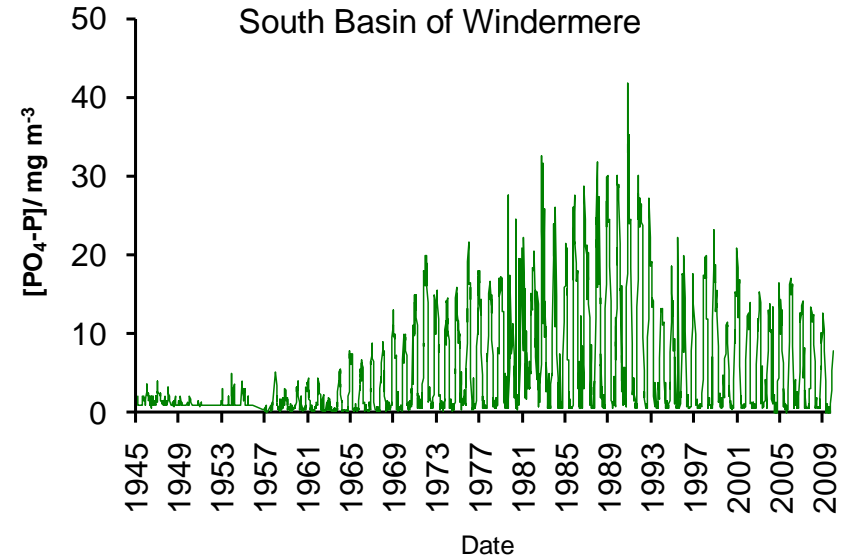
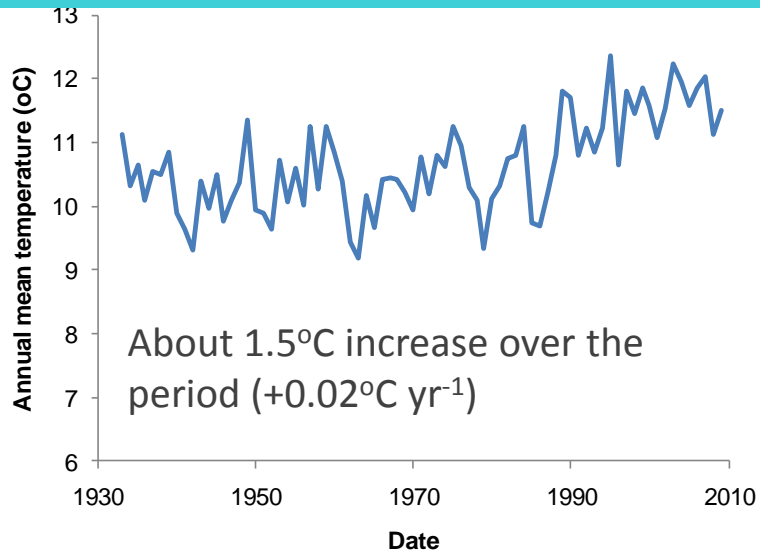
Ben James



Mike Clarke

Costs NERC ~£270k pa and involves >3 FTE

Detection & attribution of change



The Lakes Tour



- Started by FBA in an *ad hoc* way: some data from 1950s, 1960s & 1970s
- FBA 1984 'Tour' first nearly- standardised tour (but no data on Chla & patchy Secchi depth)
- Subsequent standardised Tours by IFE/CEH in:
 - 1991, 1995, 2000, 2005, 2010 & 2015 (just finished)

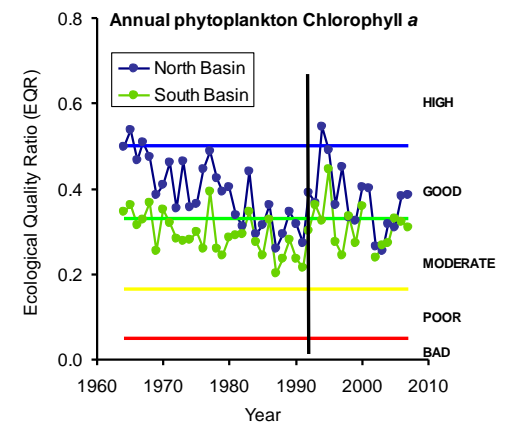
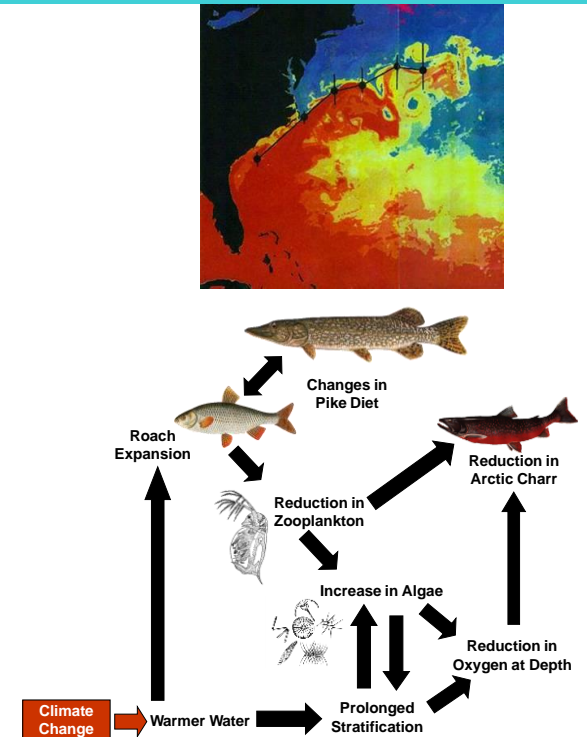
What the tour involves

- 20 Lake Basins
- Four visits per year (Jan, Apr, Jul and Oct)
- Standardised measurements:
 - Depth profiles of temperature and oxygen
 - Secchi depth
 - pH, alkalinity and major anions and cations
 - Plant nutrients
 - Phytoplankton chlorophyll *a* and species
 - Zooplankton abundance and species
- Since 2010:
 - heavy metals
 - micro-organics (pesticides & herbicides)
 - review of fish populations

2015 tour carried out by CEH and the EA with support from United Utilities and Natural England (fish).

An alphabet of issues

- Acidification
- Biodiversity
- Climate change
- Conservation
- Distribution of organisms
- Eutrophication
- Invasion/ expansion of non-native species
- Lake management
- Macronutrient cycling C, N, P, Si
- Phenological change
- Remediation
- Teleconnexions
- Trophic interactions
- Water Framework Directive supporting science



High-frequency measurements on lakes



AWQMS on Blelham Tarn

- Met sensors
- Temperature profiles

Sub-surface:

- Oxygen
- pH
- Conductivity
- CO₂
- Underwater light
- Chla
- Cyanobacterial pigment

4-minute data
telemetered back
to CEH database
(& internet site)



Eleven lakes in UK

- Objectives:** i) to forecast algal blooms
ii) to determine meteorological effects on C-cycling in lakes
iii) to determine short-term coherence in lake behaviour

Demonstration project with: Universities of Lancaster, Loughborough, Glasgow, UCL, UK
Astronomy Technology Centre. Plus: NRW, AFBI, OTT Hydrometry, Lakeland Instrumentation

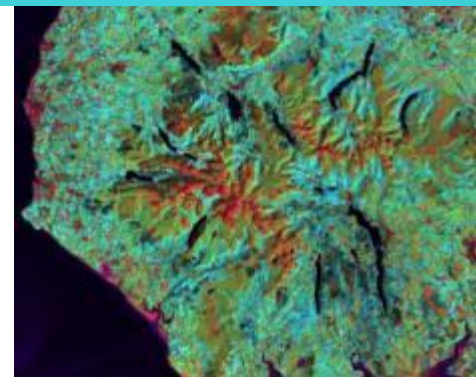


GloboLakes- Observing lakes from space

NERC 5-year Consortium grant

Objectives

- To produce a global lake observatory based on EO
- 1000 lakes at a fortnightly to monthly frequency,
- Extending back ~15 years
- First synoptic view of global lake condition and cause of change for phytoplankton & blue-green algae, surface temperature, dissolved solids & dissolved organic matter
- Assess evidence for temporal coherence & forecast future change (PROTECH)
- Produce a durable platform establishing the UK as the centre of excellence for remote sensing of lakes
(See FBA News Spring 2013 and <http://www.globolakes.ac.uk/>)



UK Lakes Portal- Cumbrian lakes

The screenshot shows the UK Lakes Portal interface. At the top, there is a header with the CEH logo, 'Centre for Ecology & Hydrology', 'UK Lakes Portal', and a search bar. Below the header is a map of Cumbria with several lakes highlighted in blue. A search bar is located above the map. Below the map is a table of lake data. The table has columns for WBID, Name, County, and Area (sq m). The table lists 10 lakes, including Windermere, Ullswater, Derwent Water, and Ennerdale Water. A 'Show 10 entries' dropdown is visible on the left, and a 'Search Table:' input field is on the right. At the bottom, there is a pagination bar showing 'Showing 1 to 10 of 276 entries' and a 'Previous' button followed by page numbers 1 through 28 and a 'Next' button.

WBID	Name	County	Area (sq m)
29233	Windermere	Cumbria	42227935
28955	Ullswater	Cumbria	25802920
47007	Windermere (N Basin)		23441177
47008	Windermere (S Basin)		18786758
28965	Derwent Water	Cumbria	15713889
28847	Bassenthwaite Lake	Cumbria	15627885
29321	Coniston Water	Cumbria	13822467
29073	Haweswater Reservoir	Cumbria	11231568
29021	Thirlmere	Cumbria	9294051
29062	Ennerdale Water	Cumbria	8930715

- Will be launched soon for public access to lake characteristics and chemistry plus: landcover in catchment (CEH Land Cover Map), biological data from Biological Records Centre and more...
- Producing a more specific Cumbrian Lake Information Portal (CLIP) for later

Conclusions

- The combination of a long-history of research and a diversity of lake types has resulted in Cumbrian lakes being among the best studied in the world
- The knowledge of the changes that have occurred and insights into causes of change is a powerful resource for lake management..... but this could be used even more effectively in the future.
- Thank you for your attention!

Loweswater

Water Body ID 28986

Loweswater is a large freshwater lake located in Cumbria, England. It is generally shallow with low alkalinity and is situated at low altitude.

Surface Area	60 ha
Mean Depth	8.4 m
Maximum Depth	16.0 m
Catchment Area	819 ha
Grid Reference	NY12442171
Altitude	125 m A.O.D.



lat, lon: 54.5830,-3.3563

Show selected lake Show all lakes Show lake catchment

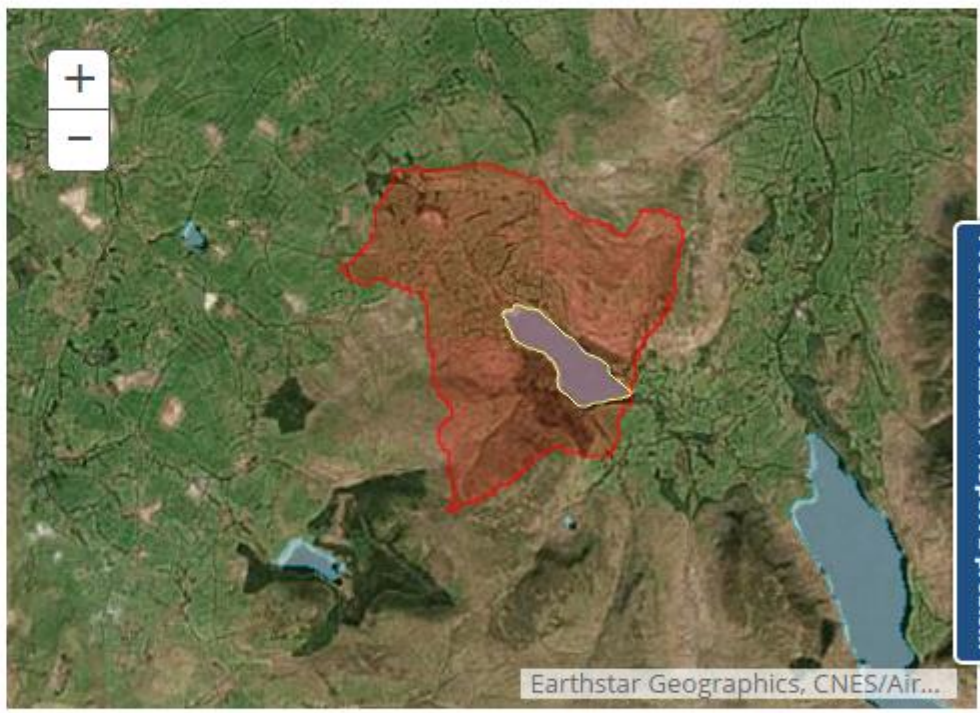


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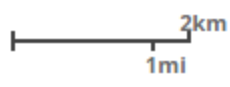
Altitude 125 m A.O.D.

This is version is for evaluation only!



lat, lon: 54.5830,-3.3563

Show selected lake Show all lakes Show lake catchment



Parameters Typology Chemistry Land cover Biology

Perimeter Length	3943 m
Shoreline Development Index [?]	1.43
Fetch Distance [?]	1676 m
Distance to Sea [?]	13172 m
Water Body Volume [?]	5048658 m3
Lake Catchment Ratio [?]	0.074

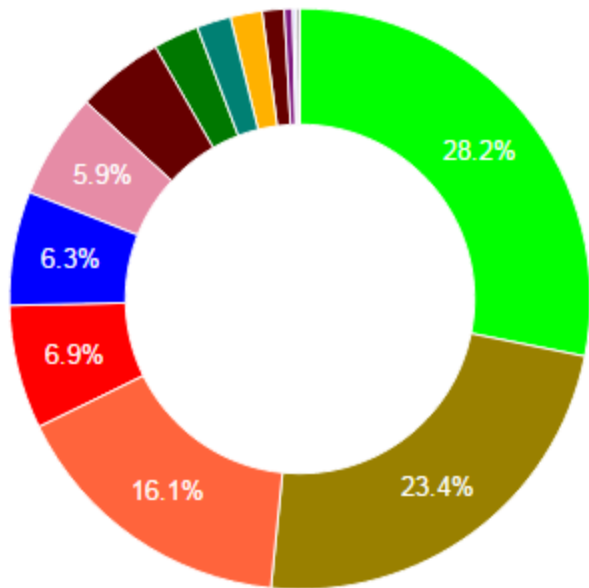
⌕ Map search

This is version is for evaluation only!

1mi

[Parameters](#)
[Typology](#)
[Chemistry](#)
[Land cover](#)
[Biology](#)

Lake catchment land cover based on CEH Land Cover Map of Great Britain, 2000.



6.90%	1.1 Broad-leaved/ mixed woodland
2.54%	2.1 Coniferous woodland
1.23%	4.1 Arable cereals
4.86%	4.2 Arable horticulture
0.00%	4.3 Arable non-rotational
28.16%	5.1 Improved grassland
0.00%	5.2 Setaside grass
1.76%	6.1 Neutral Grass
0.03%	7.1 Calcareous grass
23.43%	8.1 Acid grassland
16.15%	9.1 Bracken
0.47%	10.1 Dense dwarf shrub heath
5.87%	10.2 Open dwarf shrub heath
0.00%	11.1 Fen, marsh, swamp
1.89%	12.1 Bog (deep peat)
6.32%	13.1 Inland water
0.00%	15.1 Montane habitats
0.20%	16.1 Inland bare ground
0.17%	17.1 Suburban/rural development
0.00%	17.2 Continuous urban
0.00%	18.1. Supra-littoral rock
0.00%	19.1. Supra-littoral sediment

This is version is for evaluation only!

Parameters Typology Chemistry Land cover **Biology**

This tab provides indication of occurrence of species in and around the lake. The data is provided by the National Biodiversity Network (NBN) and its use is subject to the NBN Gateway Terms and Conditions. For more information about this tab please read Where do the biological data from?

Fetch NBN Data This site is available on NBN Gateway Start and end year: 2000

Filter table by major groups: fish bird amphibian reptile mollusc alga lichen fungus insect any

Found 539 taxa around this lake.

Show 10 entries

Quick Search:

Common Name	Name	Rank	Group	Observations
Atlantic Salmon	+ Salmo salar	Species	bony fish (Actinopterygii)	9
Brown Trout	+ Salmo trutta subsp. fario	Subspecies	bony fish (Actinopterygii)	1
Perch	+ Perca fluviatilis	Species	bony fish (Actinopterygii)	1
Pike	+ Esox lucius	Species	bony fish (Actinopterygii)	1
	+ Lampetra	Genus	jawless fish (Agnatha)	1

Showing 1 to 5 of 5 entries (filtered from 539 total entries) Previous 1 Next