



UK-SCAPE

The Cumbrian Lakes monitoring platform

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UK Centre for
Ecology & Hydrology



Natural
Environment
Research Council



The Cumbrian Lakes platform teaches us much about:

- fundamental ecosystem dynamics
- responses to environmental change

...but how can we maximise the impact of this research?

Warming waters

- Documentation of long-term warming trend
- E.g. north basin of Windermere, anomalies from 1981-2010 baseline

Warming trend revealed in eight decades of Cumbrian lake temperature records

Submitted by **Katie Muchan** on Mon, 27/01/2020 - 15:11

It is widely accepted that we are experiencing climate change. Though it is challenging to predict its future impacts, we expect to see changes to weather patterns and the frequency of extreme events, melting sea ice, and rising sea levels, all of which pose a threat to human society and ecosystems.

When discussing climate change, much attention is paid to the higher air temperatures that we are experiencing. For instance the five warmest years in the measured UK air temperature record (since 1910) **occur post-2000**, while **2010-2019 was the second warmest decade**, slightly behind the 2000s. What is often overlooked is the associated increase in surface water temperatures in freshwater systems, such as rivers and lakes. In this blog post, we use data collected from a long-term monitoring scheme in the English Lake District to investigate variation in lake temperature from 1945 to 2018.



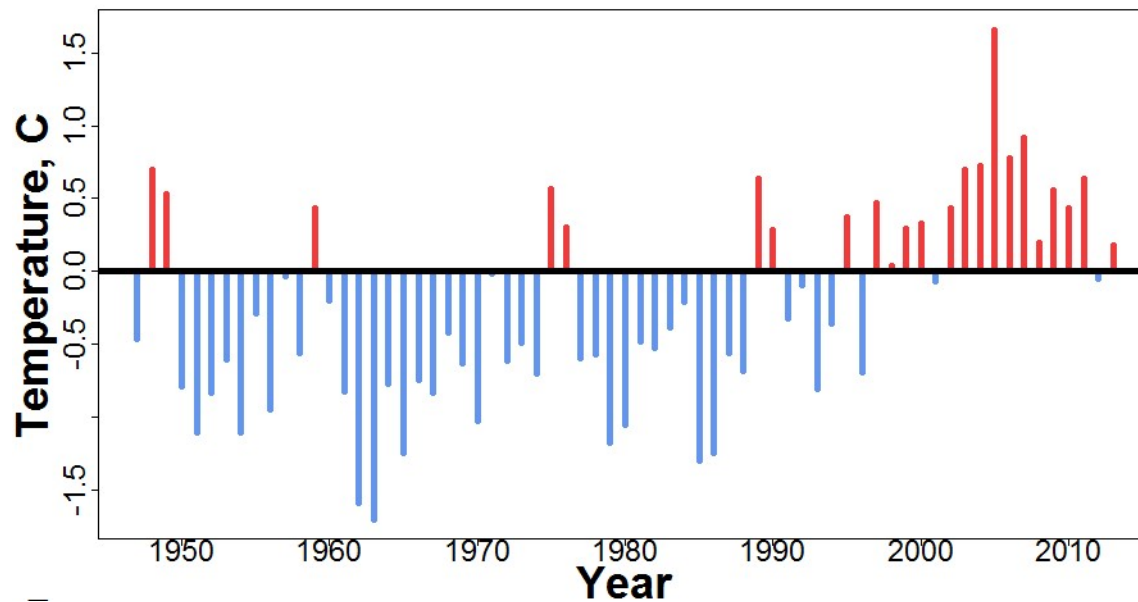
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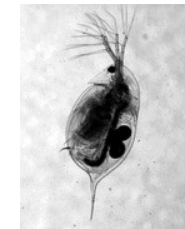
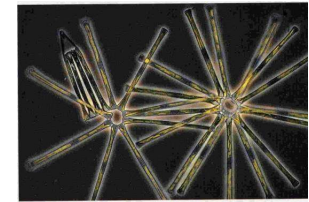
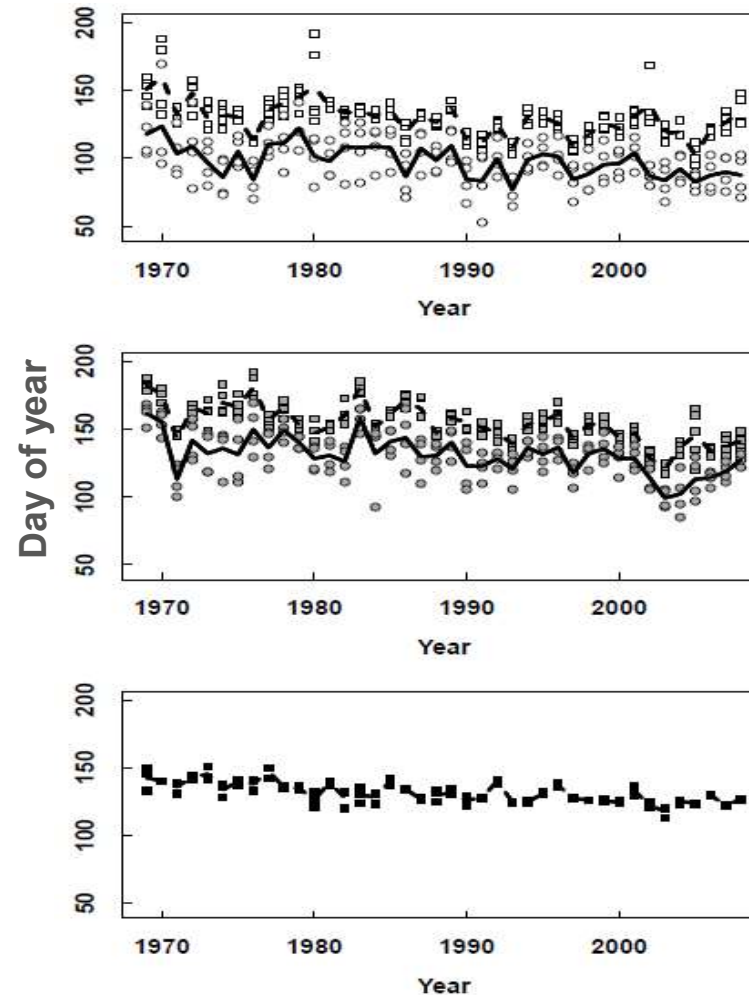
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2019-11-07

Shaping the Development of the CEH UK-SCAPE Data



Shifting seasons

- Earlier seasonal events, on average
- Among-species variation
- Possible impacts on populations



Thackeray et al. (2013) Global Change Biology, 19: 3568-3580

Shifting seasons

- Earlier seasonal events, on average
- Among-species variation
- Possible impacts on populations
- **Input to global assessments**

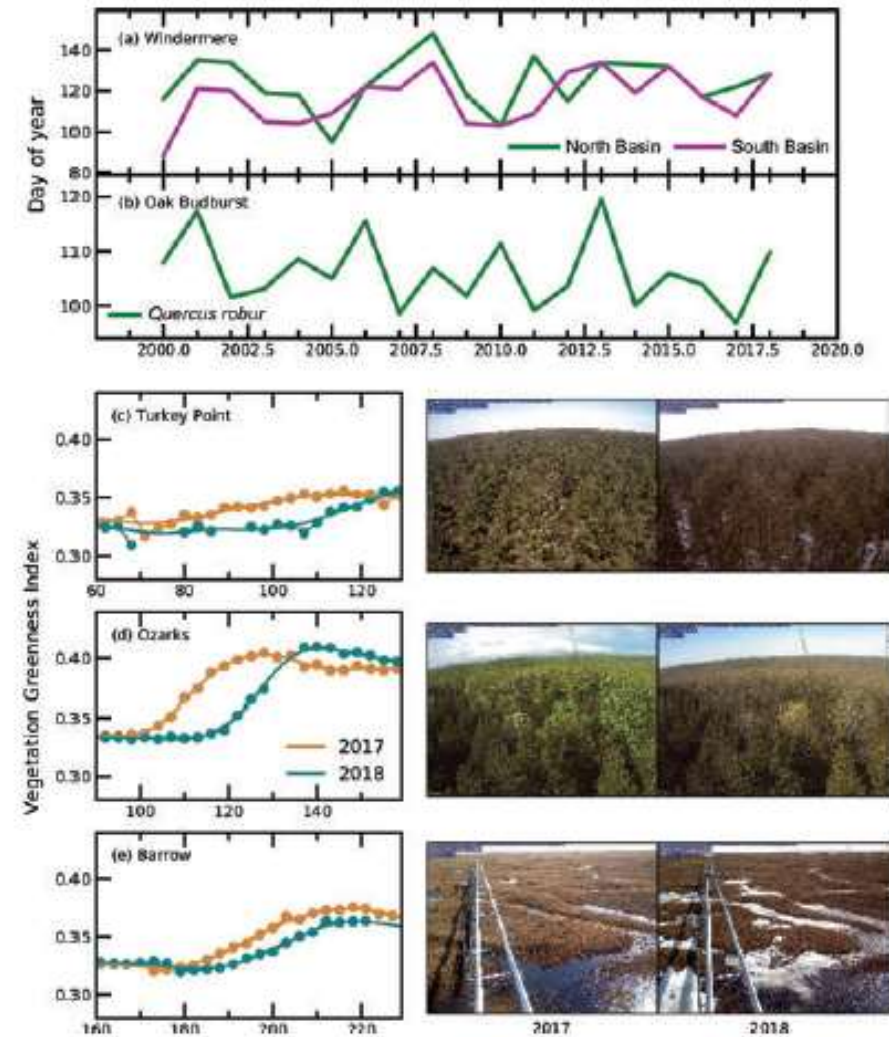
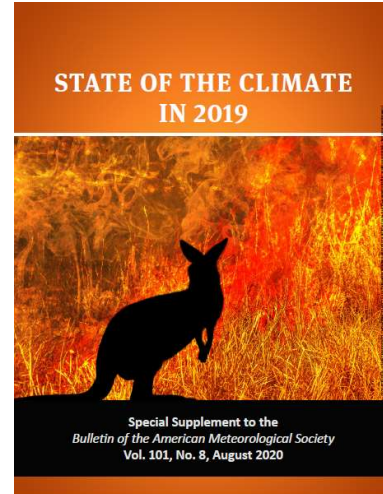


FIG. 2.70. Time series of day of year of (a) spring phytoplankton peak in the North and South Basins of Lake Windermere, UK, and (b) UK mean budburst of Pedunculate Oak (*Quercus robur*) monitored by Nature's Calendar. Spring trajectory for 2017 (earlier) and 2018 (later) vegetation greenness index derived from PhenoCam imagery at three sites across North America: (c) Turkey Point (upper), (d) Ozarks (middle), (e) Barrow (lower). PhenoCam photographs show visually obvious differences in the state of each ecosystem on the same day of year (Barrow = 27 Jun, Ozarks = 30 Apr, Turkey Point = 18 Apr) in 2017 (middle column) and 2018 (right column).

Multiple stressors

- Warming, nutrient enrichment, species introduction...
- Contribution to European analysis of whether these stressors interact
- Lakes: nutrient enrichment effects dominate over other stressors

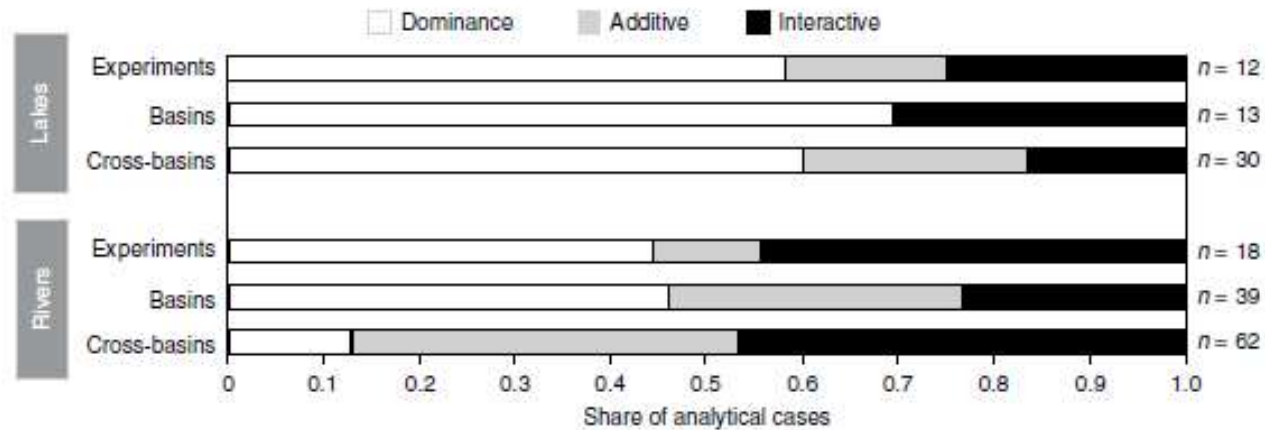
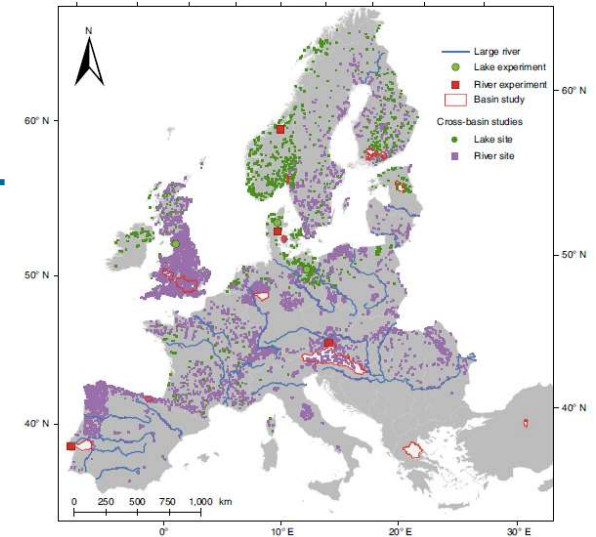
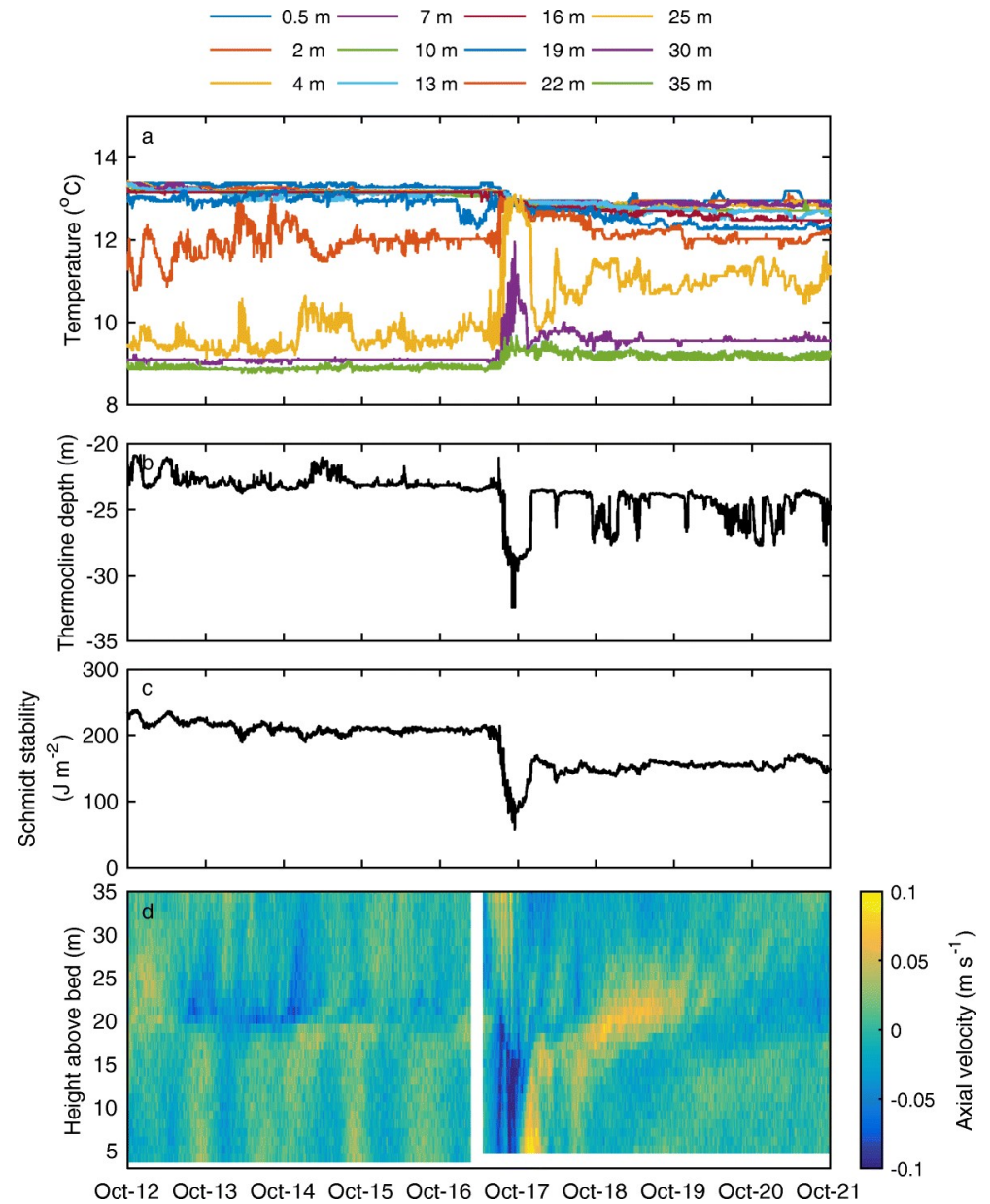


Fig. 2 | Stressor effect types in lakes and rivers. Share of analytical cases across experiments, basin studies and cross-basin studies from lakes ($n = 55$) and rivers ($n = 119$), for which only a single stressor (dominance), both stressors (additive) or their interaction significantly contributed to the variability of the biological response.

Extreme events

- Storm Ophelia (16th October 2017)
- 25-fold increase in wind energy
- High-resolution data shows major disruption to the lake water column
- Upwelling of cold, oxygen-poor water, entering the River Leven

Woolway et al, 2018, *Climatic Change*, 151: 333-347



Introduced species

- First capture of non-native fish species (ruffe) in Windermere, in September 2019
- Confirms 2015 eDNA detection (Hänfling et al, 2016, *Molecular Ecology*, 25: 3101–3119)

Non-native ruffe found in Windermere for the first time

Submitted by **Paulette Burns** on Tue, 01/10/2019 - 16:15

Scientists have made the first conclusive sighting of ruffe in Windermere - a fish species previously unrecorded in the lake but whose presence had been inferred by environmental DNA (eDNA) surveys.

Ruffe (*Gymnocephalus cernuus*), a relative of the more familiar perch, is not native to Windermere or the northern UK but has specific traits that mean it can thrive if introduced to new habitats. A single individual was found when CEH scientist Ben James and colleagues examined catches from the UK Centre for Ecology & Hydrology's long-term fish community monitoring in September 2019.

The finding confirms the presence of ruffe in the lake, which had already been inferred from environmental DNA surveys carried out in 2015.



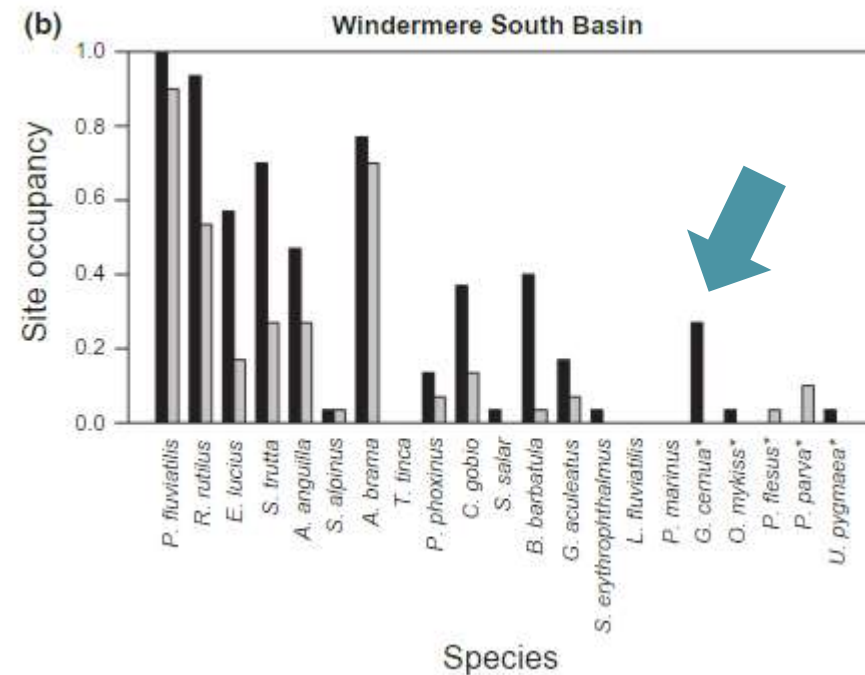
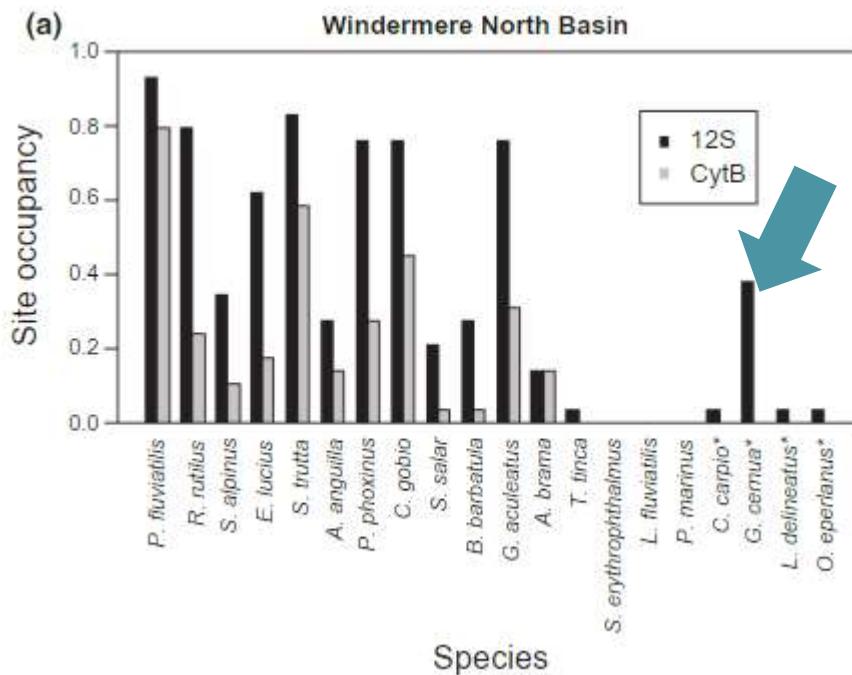
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Principal Investigator

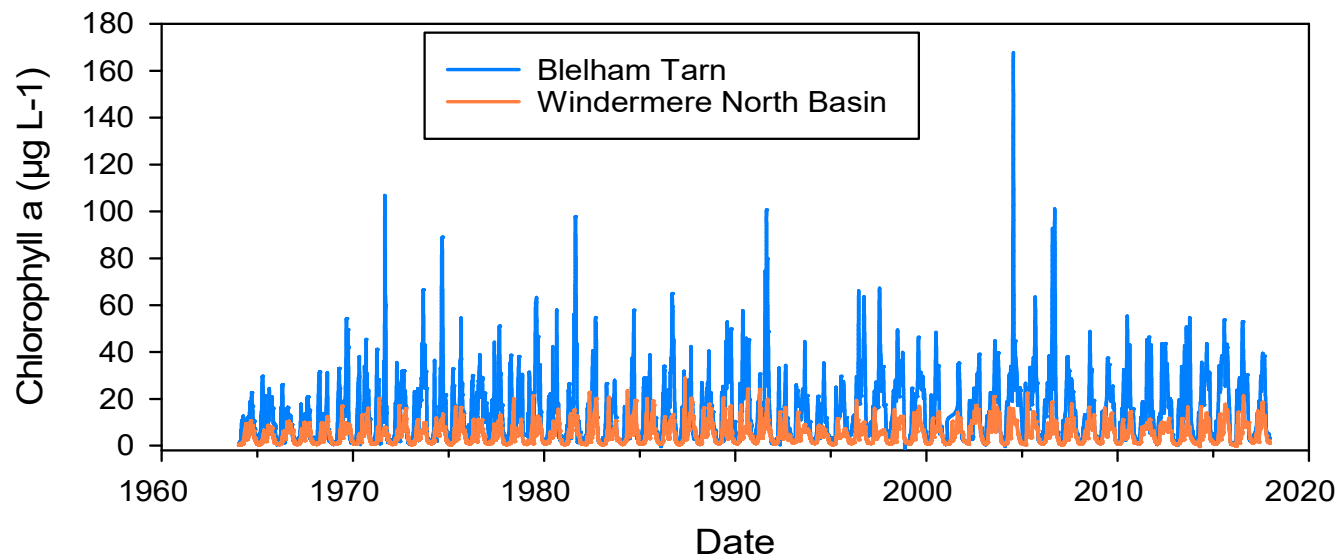


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Location: Lancaster



Long-term monitoring

- Decadal/inter-annual/seasonal-scale change
- 4 lake basins – varying in size, hydrology and productivity
- Long-term (1945-present), fortnightly data:
 - Physical: temperature, transparency
 - Chemical: nutrients, pH, alkalinity, oxygen
 - Biological data: phyto- and zooplankton, fish (annual, in Windermere)

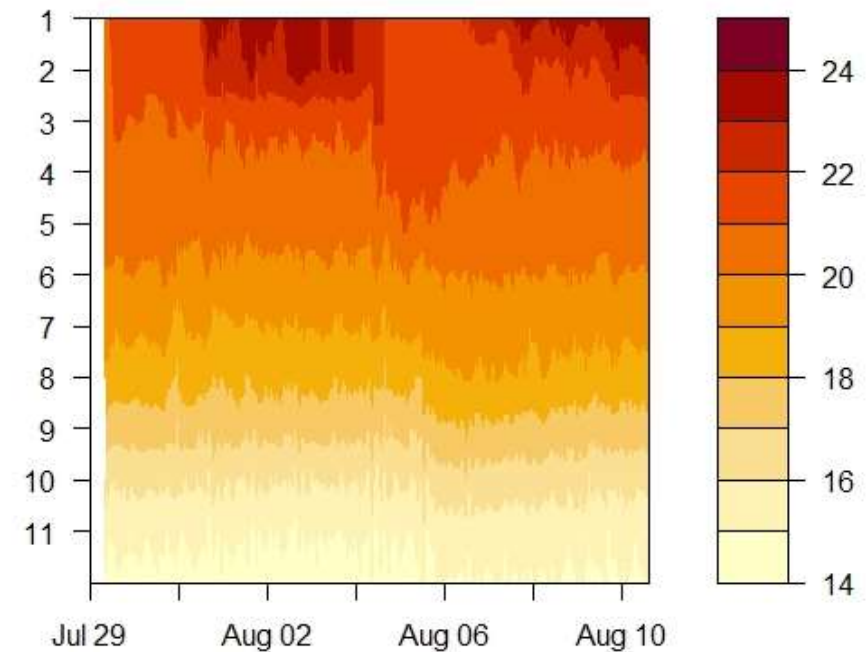


High-res monitoring

- Sub-daily/day-to-day lake dynamics
- Near real-time high-frequency (4min) buoy data
 - Meteorology (incoming radiation, air temperature, relative humidity, wind)
 - Water temperature, pH, oxygen, chlorophyll
- Esthwaite winch/profiler: 26,400 individual measurements per week!
 - Water temperature, oxygen, pH, conductivity, chlorophyll



Water Temperature (Deg C)



Take-home messages

- The Cumbrian Lakes platform delivers lake ecosystem data and understanding at multiple time scales.
- These data teach us much about fundamental ecosystem dynamics.
- The platform is available for the community to work with, to advance understanding.
- ...but, how can we do better at translating data and research into evidence and knowledge?

Questionnaire, before lunch

Your current awareness and views on the
Cumbrian Lakes Monitoring Platform

Break out discussion group, 14:00-15:15

How can we improve your ability to make use of
the Cumbrian Lakes Monitoring Platform?

Please provide specific examples...