UK-SCAPE

The Cumbrian Lakes monitoring platform

Steve Thackeray

@SteveThackeray
@UKCEH_LakeEco

UK Centre for Ecology & Hydrology

UKRI Natural Environment Research Council

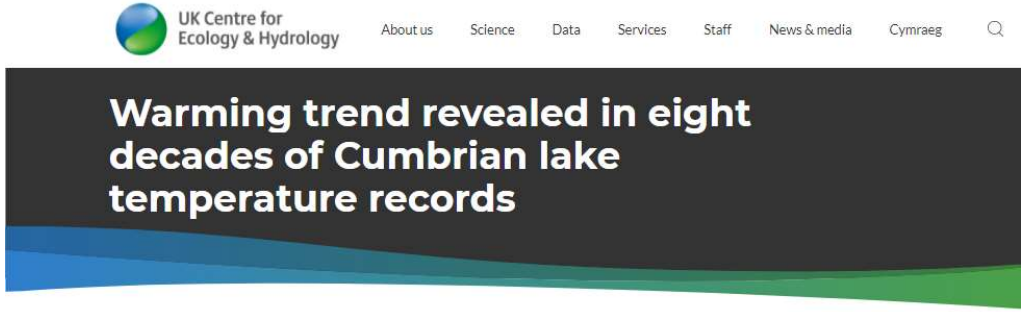
The Cumbrian Lakes platform teaches us much about:

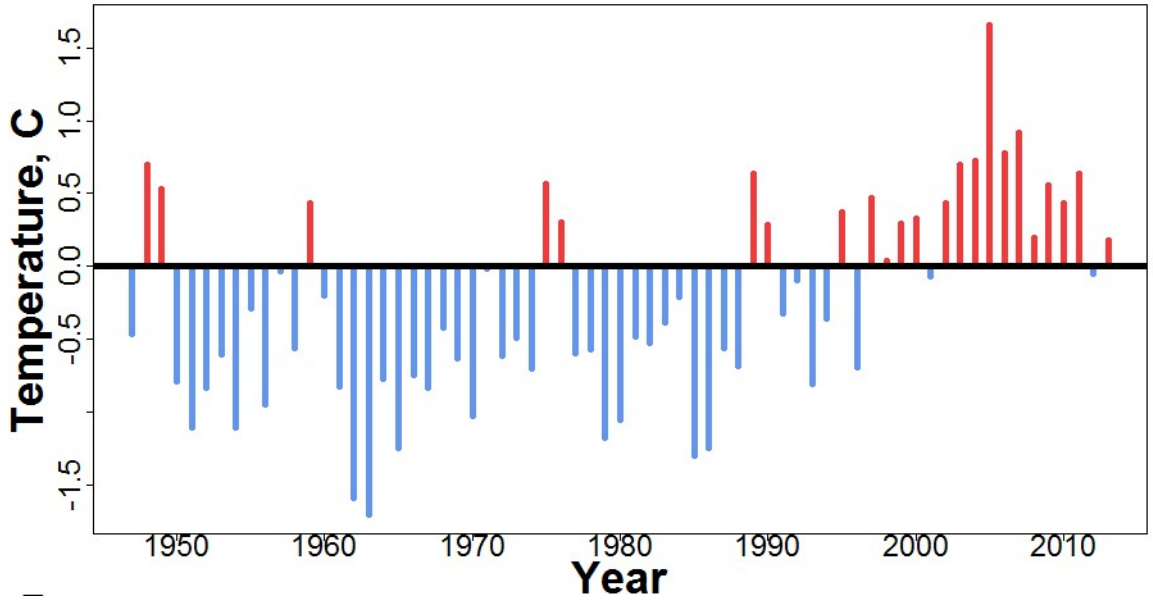
- fundamental ecosystem dynamics
- responses to environmental change

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

Warming waters

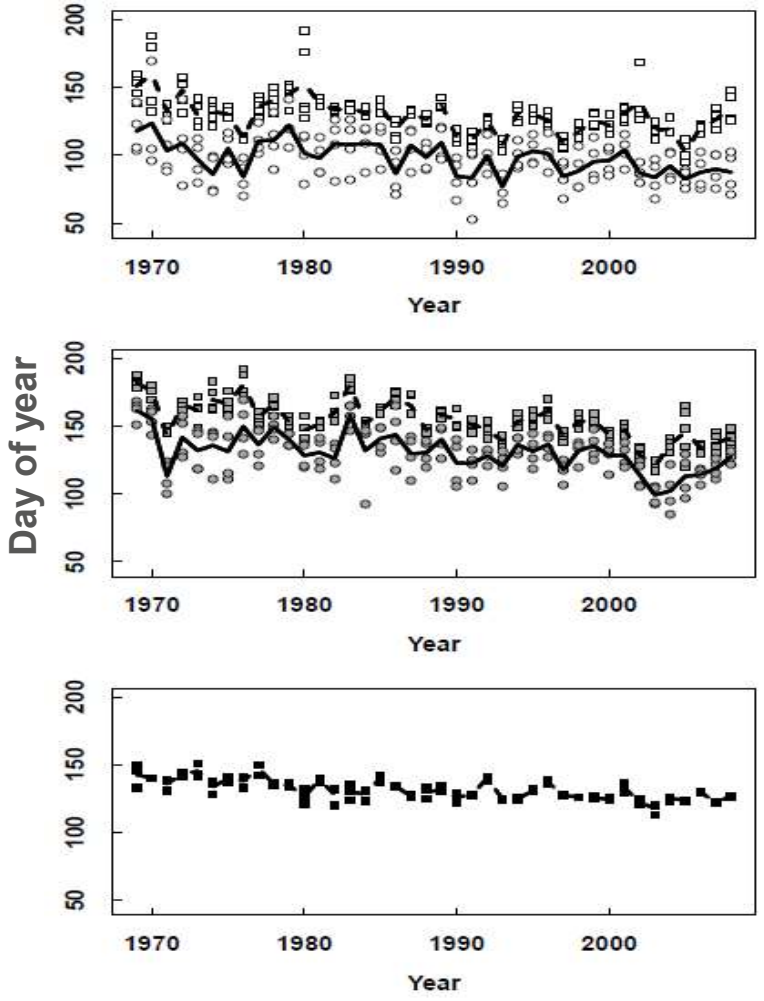
- Documentation of long-term warming trend
- E.g. north basin of Windermere, anomalies from 1981-2010 baseline

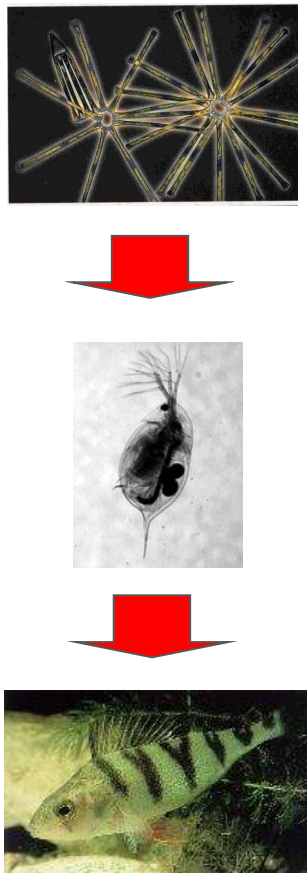




Shifting seasons

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

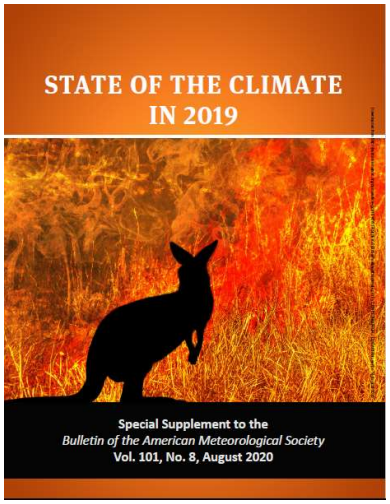




Thackeray et al. (2013) Global Change Biology, ***19:*** *3568-3580*

Shifting seasons

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



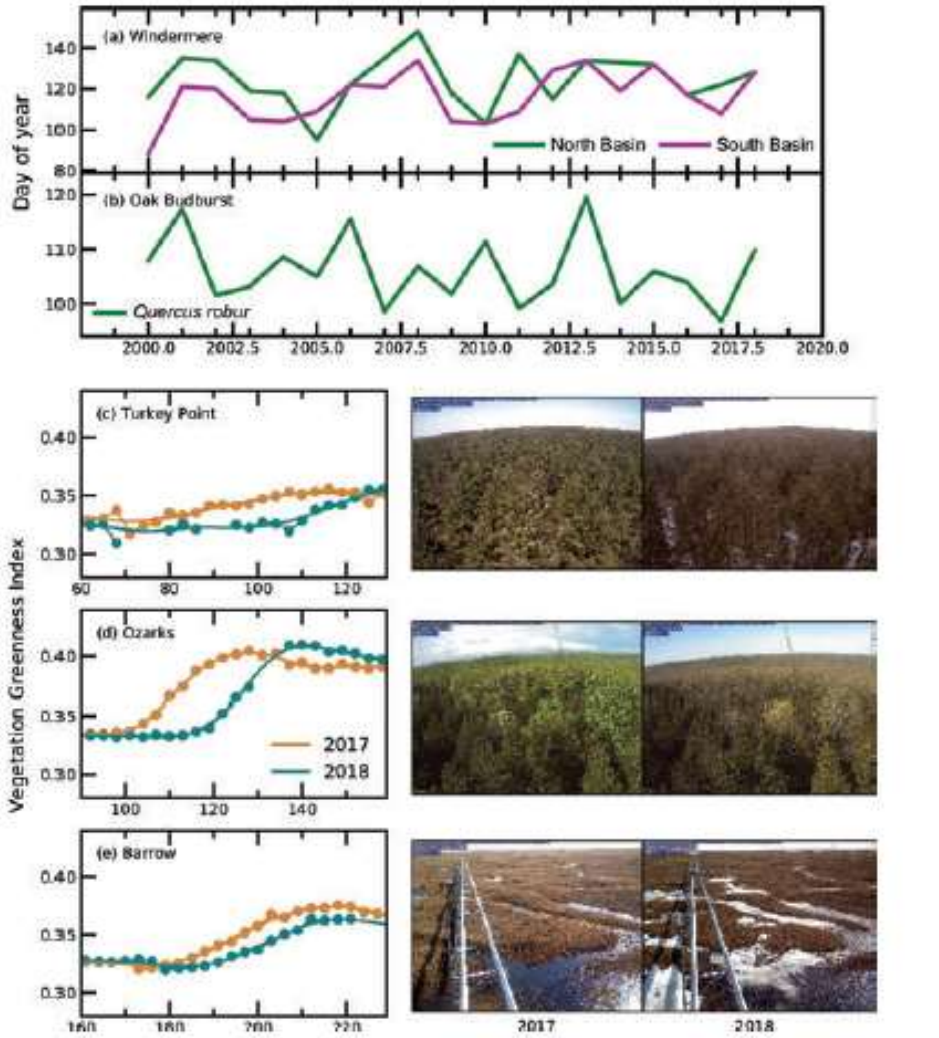
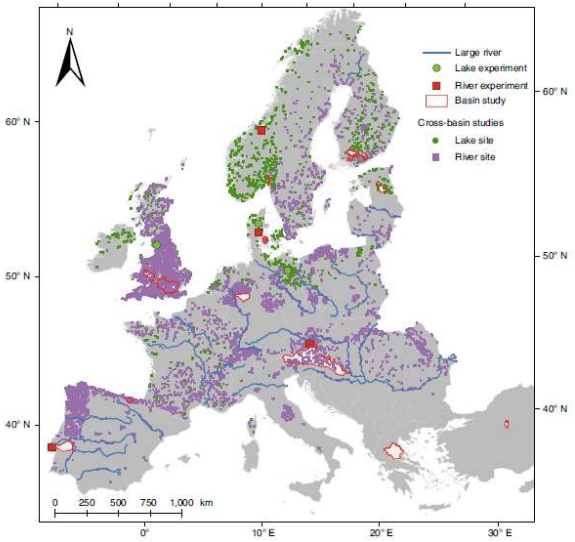


FIG. 2.70. Time series of day of year of (a) spring phytoplankton peak in the North and South Basins of Lake Windermere, UK, and (b) UK mean budburst of Pedunculate Oak (*Quercus robur*) monitored by Nature's Calendar. Spring trajectory for 2017 (earlier) and 2018 (later) vegetation greenness index derived 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



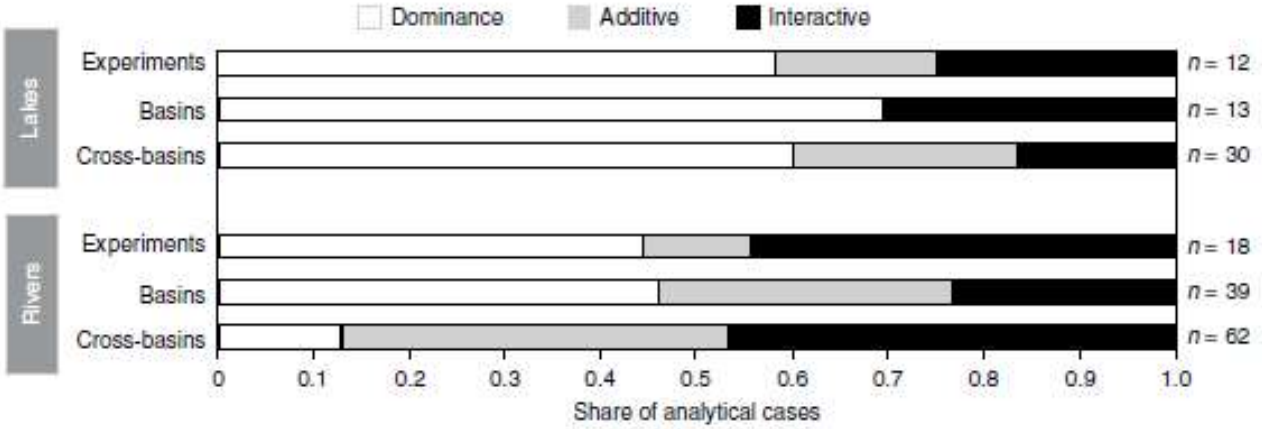
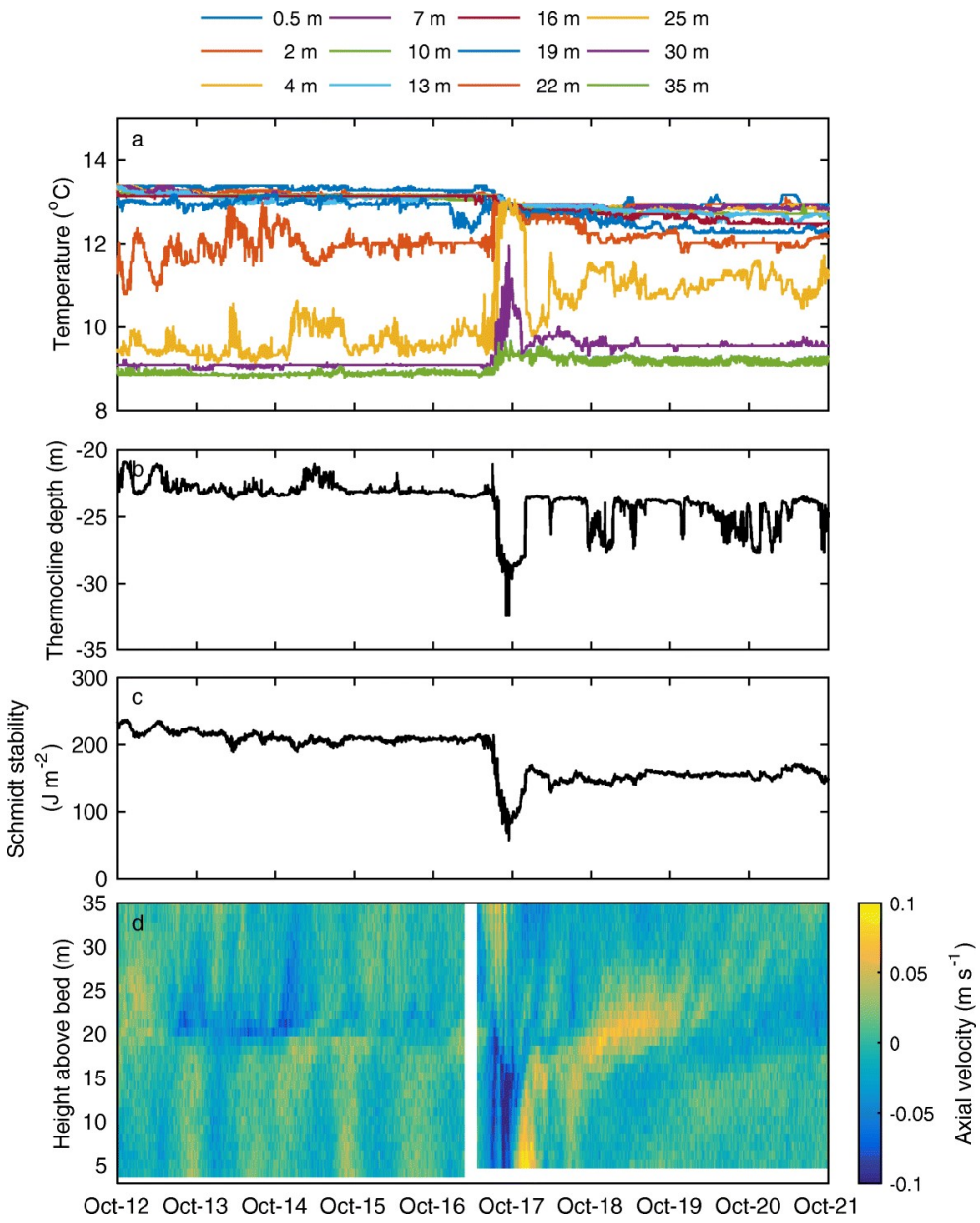


Fig. 2 | Stressor effect types in lakes and rivers. Share of analytical cases across experiments, basin studies and cross-basin studies from lakes ($n = 55$) and rivers ($n = 119$), for which only a single stressor (dominance), both stressors (additive) or their interaction significantly contributed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

Birk et al, 2020, *Nature Ecology & Evolution*, 4: 1060-1068

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

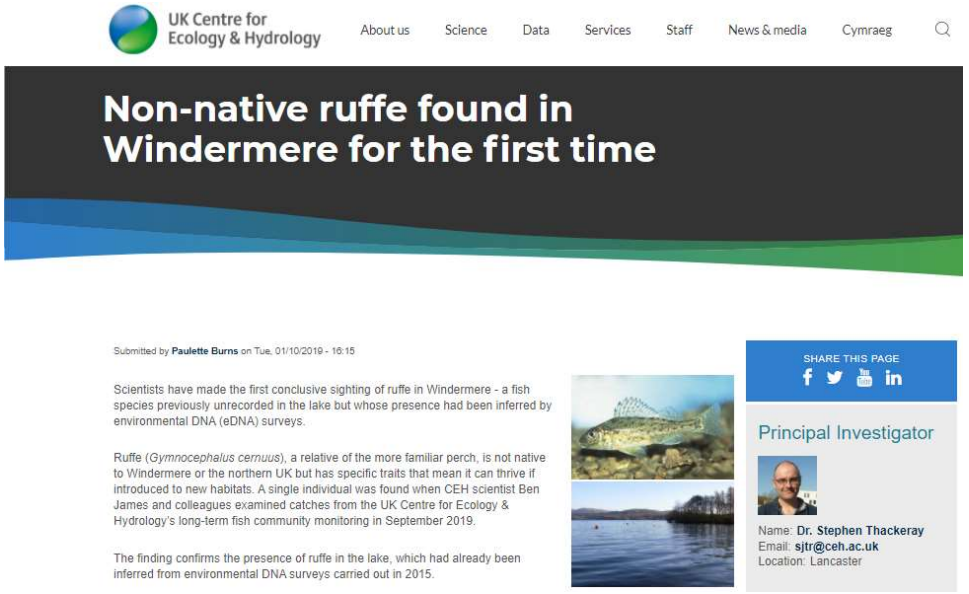


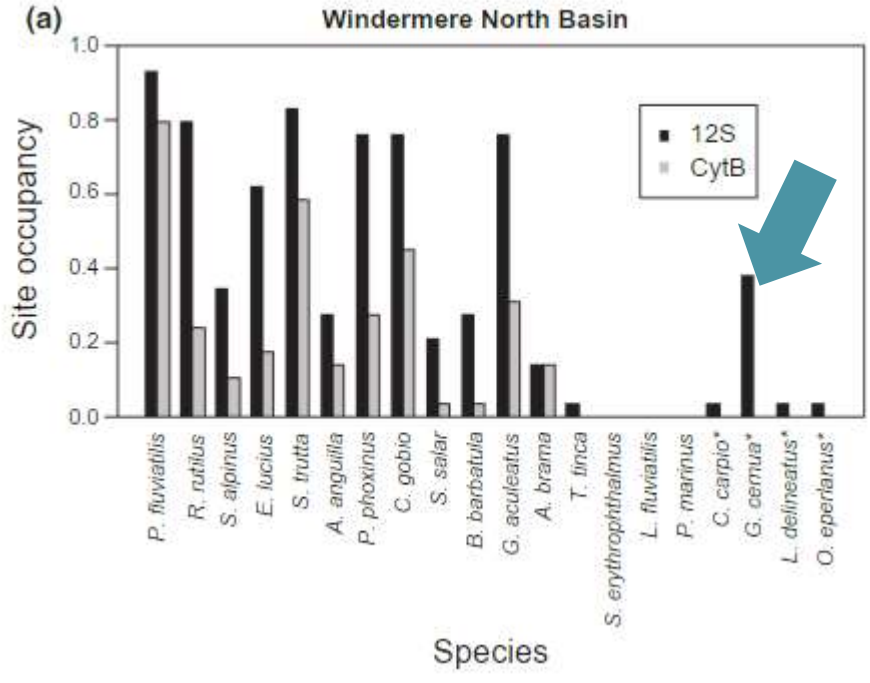
Woolway et al, 2018, *Climatic Change*, 151: 333-347

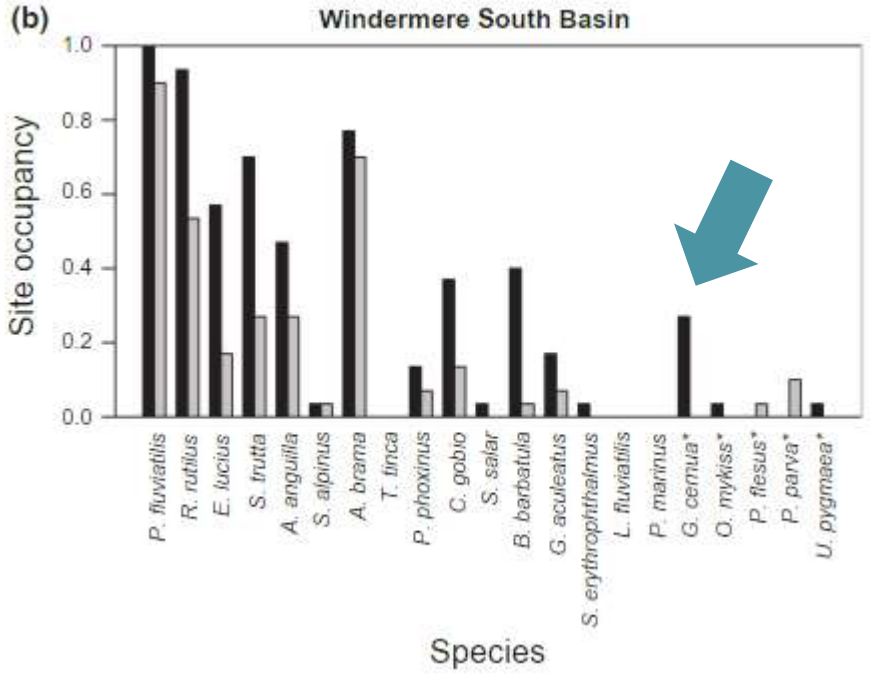
Introduced species

- 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)

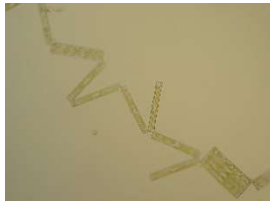


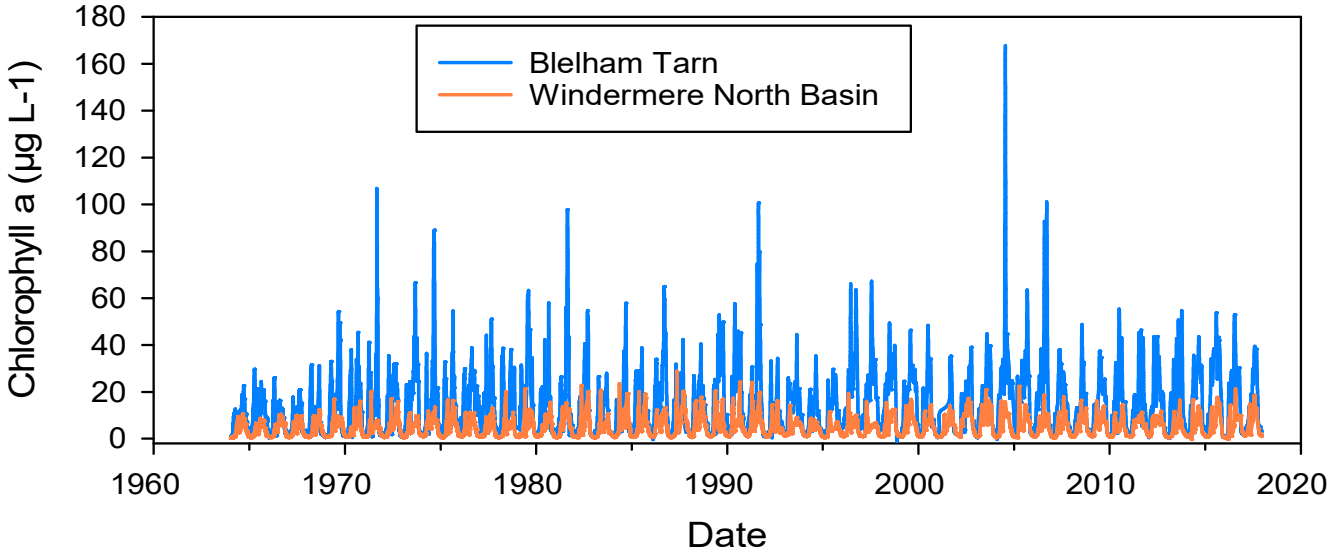




Long-term monitoring

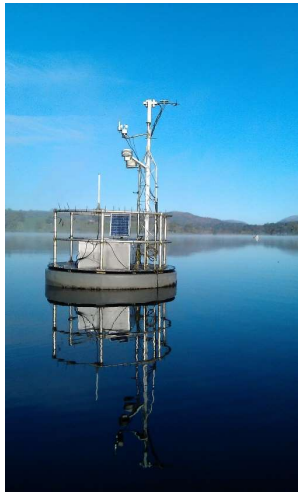
- Decadal/inter-annual/seasonal-scale change
- 4 lake basins – varying in size, hydrology and productivity
- Long-term (1945-present), fortnightly data:
  - Physical: temperature, transparency
  - Chemical: nutrients, pH, alkalinity, oxygen
  - Biological data: phyto- and zooplankton, fish (annual, in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

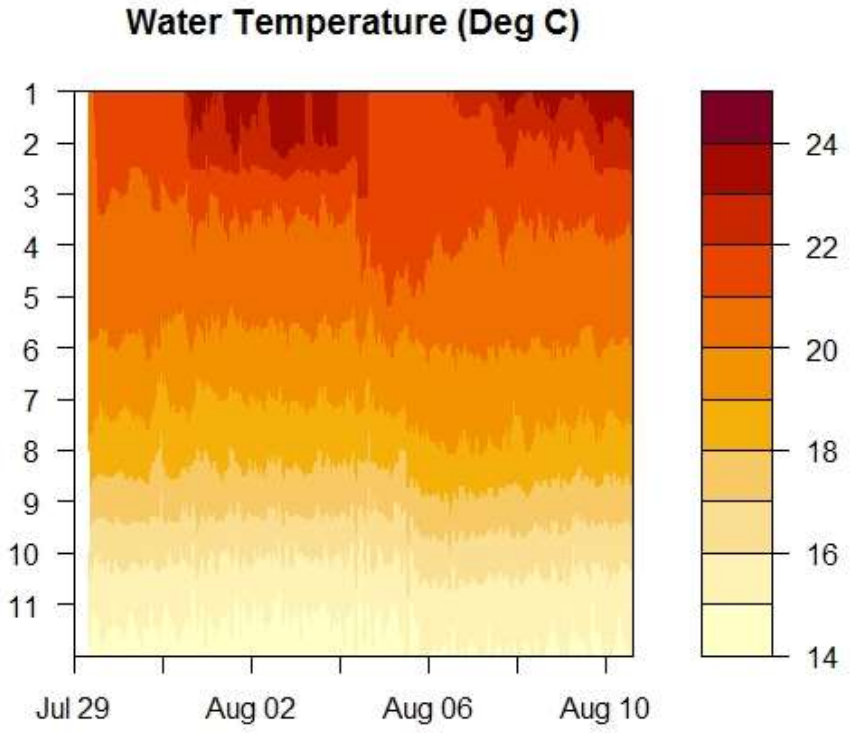




High-res monitoring

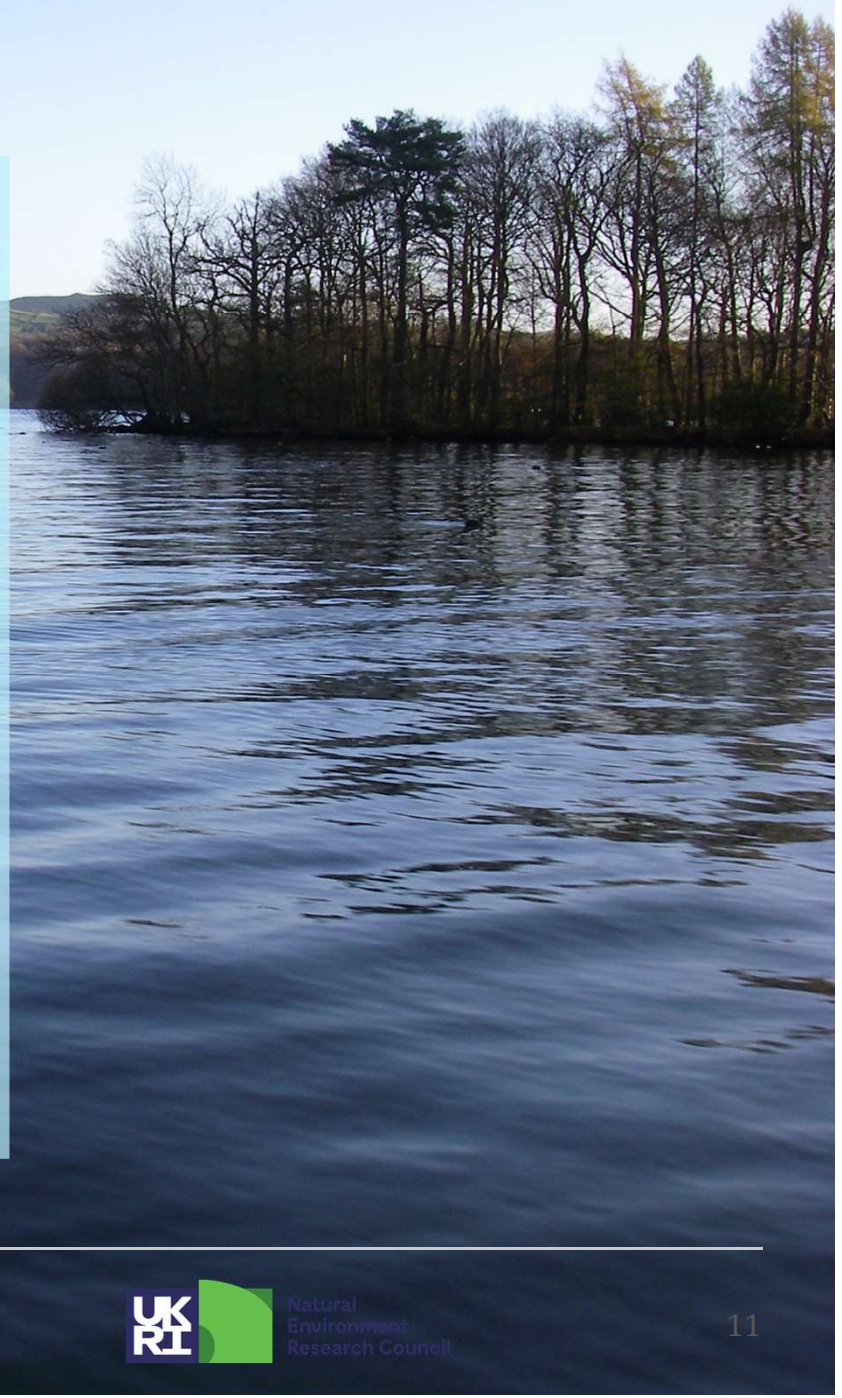
- Sub-daily/day-to-day lake dynamics
- Near real-time high-frequency (4min) buoy data
  - Meteorology (incoming radiation, air temperature, relative humidity, wind)
  - Water temperature, pH, oxygen, chlorophyll
- Esthwaite winch/profiler: 26,400 individual measurements per week!
  - Water temperature,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





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…