

Building the evidence base for Windermere to inform future management and restoration

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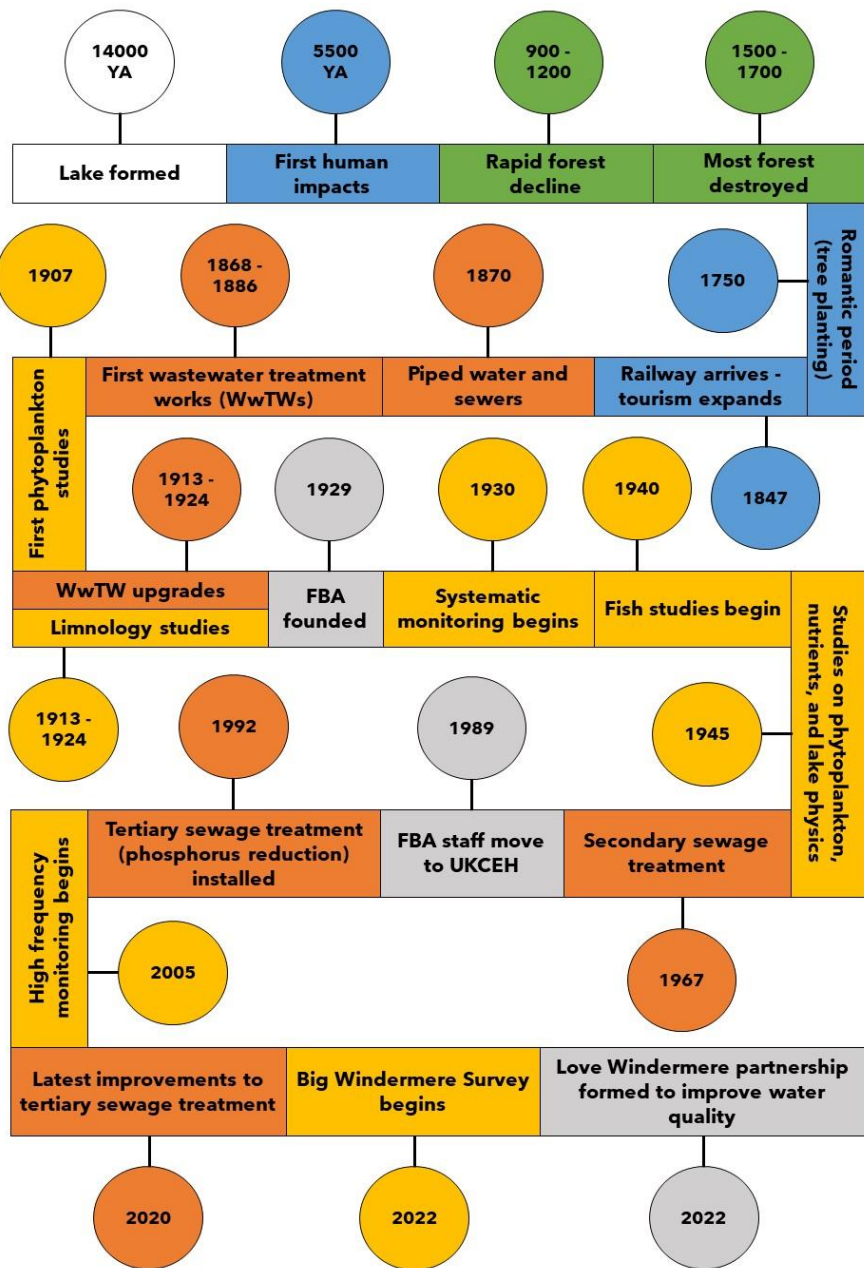
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Windermere

- England's largest natural lake in UNESCO Lake District World Heritage site.
- Ecologically important, e.g. Arctic charr.
- Major destination for tourism and recreation.
- Concerns have been raised about the health of lake.
- One of the best studied lakes in the world with records dating back to the 1930s.
- Intra-annual, decadal and centennial insights on lake response to natural change, human pressures and remedial actions.





Timeline for Windermere

History

- Prior to the Industrial Revolution, water quality in the Lake District is unlikely to have changed much over time except in response to major events.
- From as early as the 1800s, wastewater influenced the deterioration of water quality.
- Improvements have been made to WwTWs but their carrying capacity can be challenged by intense rainfall, population size, and the range of organic and synthetic compounds now going down drains.
- Many properties in the Lake District are not connected to mains sewage and rely on private package treatment plants and septic tanks.

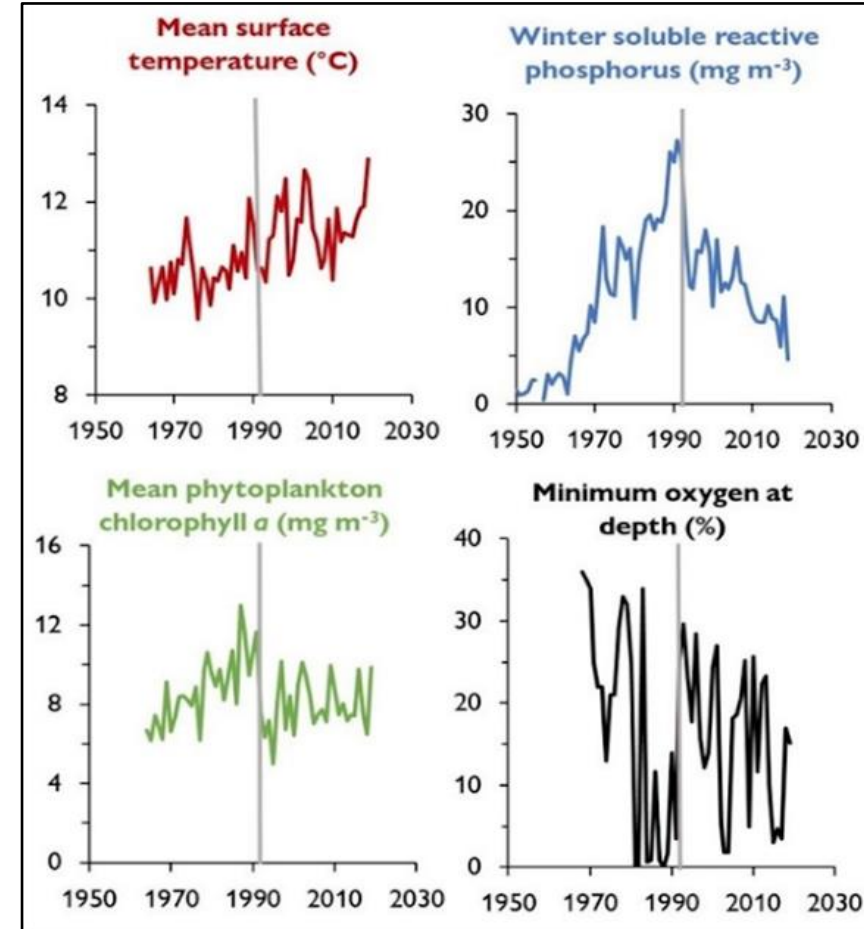


History

- After the railway arrived in 1847, tourism grew and major settlements expanded.
- Agriculture has intensified over time, particularly with the major move from arable farming to livestock production in the 18th and 19th centuries.
- Fish farming also played a role.
- Climate change means waters are warming up, which depletes oxygen and has knock-on effects for timing of hydrological and biological processes.
- More invasive non-native species are establishing themselves and becoming almost impossible to eradicate with consequences for native species.

Current situation

- Overall ecological status in 2022 was Moderate, while both basins improved from Moderate to Good phosphorus status.
- Bathing water quality at 4 designated sites has remained at Excellent status since 2018 (see Swimfo).
- Heavy metal concentrations have decreased but can still exceed thresholds at local scale.
- Nutrient concentrations are being reduced, but not far enough to counter the effects of climate change.
- Concentrations of many emerging pollutants (e.g. plastics, pharmaceuticals) may be rising due to increases in population, changing age profile and pharmaceutical consumption.



Outlook

- Improving water quality will require nutrient inputs from agriculture, septic tanks, private sewage treatment and wastewater treatment works to be identified and reduced.
- Overflow discharge of untreated sewage at times of heavy rainfall, and animal faecal waste from agricultural land, contain microbes that could potentially impact human health.
- A better scientific understanding is needed of how waterbodies in the Leven catchment will respond to future multiple pressures in order to guide future management and restoration.



Love Windermere Partnership (LWP)



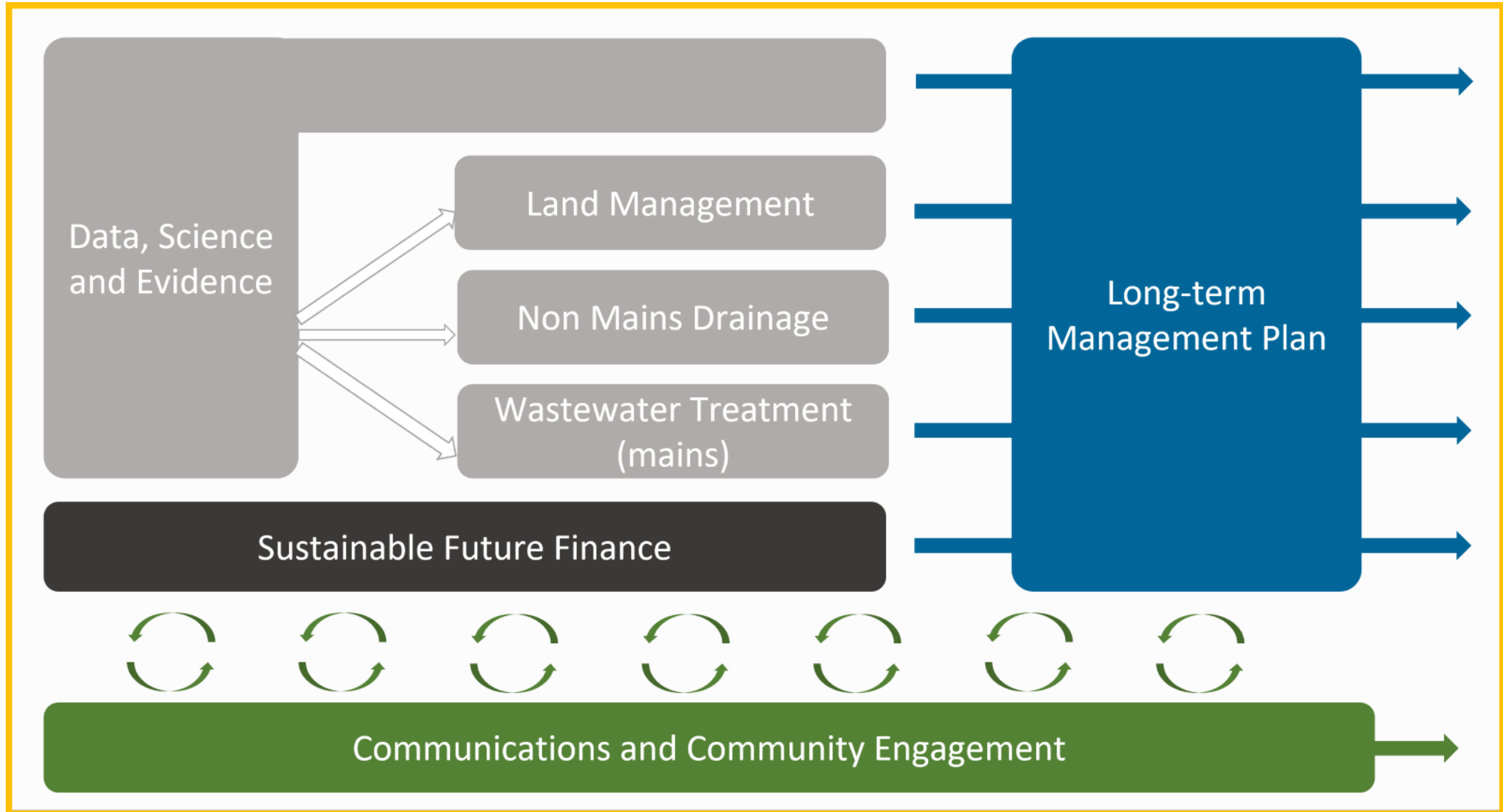
“The partnership aims to use our collective expertise to identify and address critical knowledge gaps regarding impacts on water quality in Windermere. By taking a scientific and evidence-based approach, we will better understand the complex and interdependent pressures facing Windermere, and prioritise effective solutions to improve the condition of the lake.”



Lake District
National Park



Workstreams



Objectives

- Produce the Windermere Integrated Science Plan (WISP).
- Produce 1st tri-annual State of Windermere Report.
- Undertake data analysis and interpretation.
- Develop and agree key science, research and monitoring questions.
- Scope and execute collaborative research projects.
- Conduct science engagement / advocacy activities.
- Liaise with other Love Windermere workstreams.
- Secure funding for near-term science and research activities.
- Provide scientific input into media enquiries.



STATE OF NATURE WINDERMERE

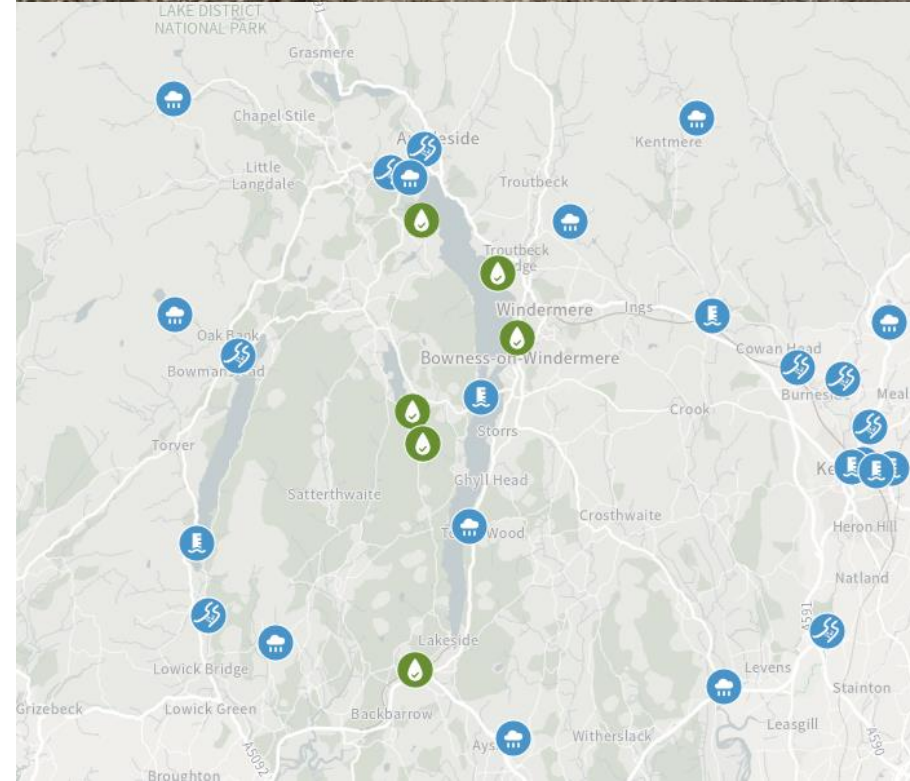
2023

state of
nature
PARTNERSHIP

What's happening now?

There is already a great deal of work going on in the Leven catchment to understand and improve water quality:

- Regulatory monitoring, inspections and enforcement by the Environment Agency.
- Long-term monitoring by UK Centre for Ecology & Hydrology.
- Farming in Protected Landscapes Programme through Defra and Lake District National Park Authority.
- United Utilities Investment Programme.
- Citizen science, volunteer projects, advocacy and education work.
- On the ground delivery programmes through organisations such as South Cumbria Rivers Trust, National Trust, Cumbria Wildlife Trust etc.





The Big Windermere Survey: a citizen science approach to monitoring water quality

Lynsey R. Harper, Emma Kelly, Trine Bregstein, Simon Johnson, Louise Lavictoire & Ben W. J. Surridge



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#BigWindermereSurvey



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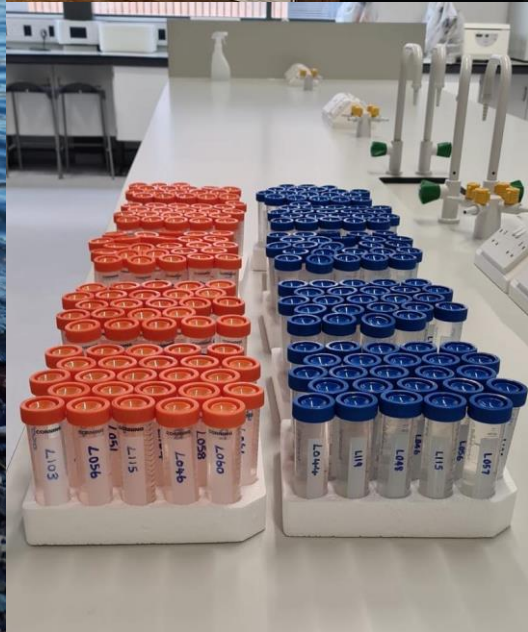
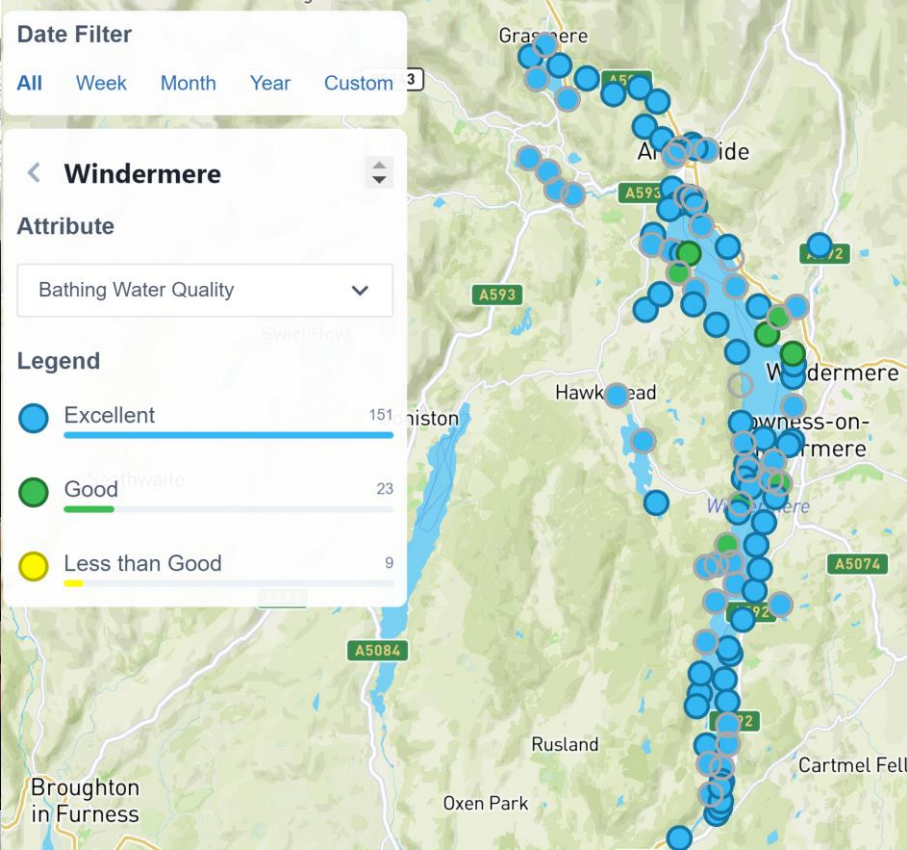
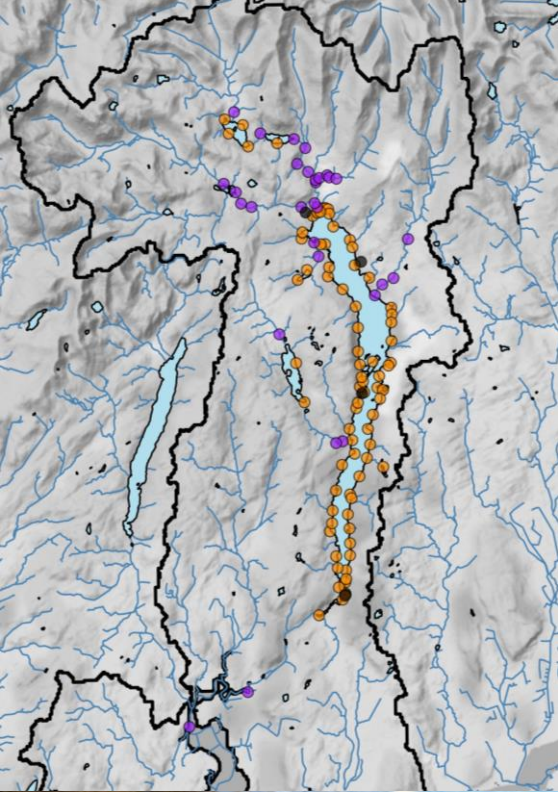


Background

The Big Windermere Survey is a citizen-science led, participatory approach to monitoring water quality in Windermere and the wider Leven catchment.

Citizen scientists are trained to collect water samples from approximately 100 different locations on Windermere and in the rivers and lakes that flow into it.

The samples are analysed at independent laboratories for nutrient and bacterial concentrations that indicate the potential for algal blooms and faecal pollution, producing the largest, one-day snapshot of conditions in Windermere.



BIG WINDERMERE SURVEY

Summary results from June 2022 survey - full information and dataset available from www.fba.org.uk/bws-june-2022

93 sites sampled by >100 people in Windermere's largest ever spatial survey

Key findings

Bacteria

- 90% of river sites meet standards for Good or Excellent quality, based on E.coli and intestinal enterococci

Phosphorus

- 96% of river sites meet standards for High or Good status
- 52% of lake sites meet standards for High or Good status; 48% meet lower standards for Moderate, Poor or Bad status

Nitrogen

- Nitrate concentrations were <1.1 mg N/L in all samples; substantially below the drinking water limit of 11.3 mg N/L
- Total ammonia concentrations were very low, many being below the detection limit

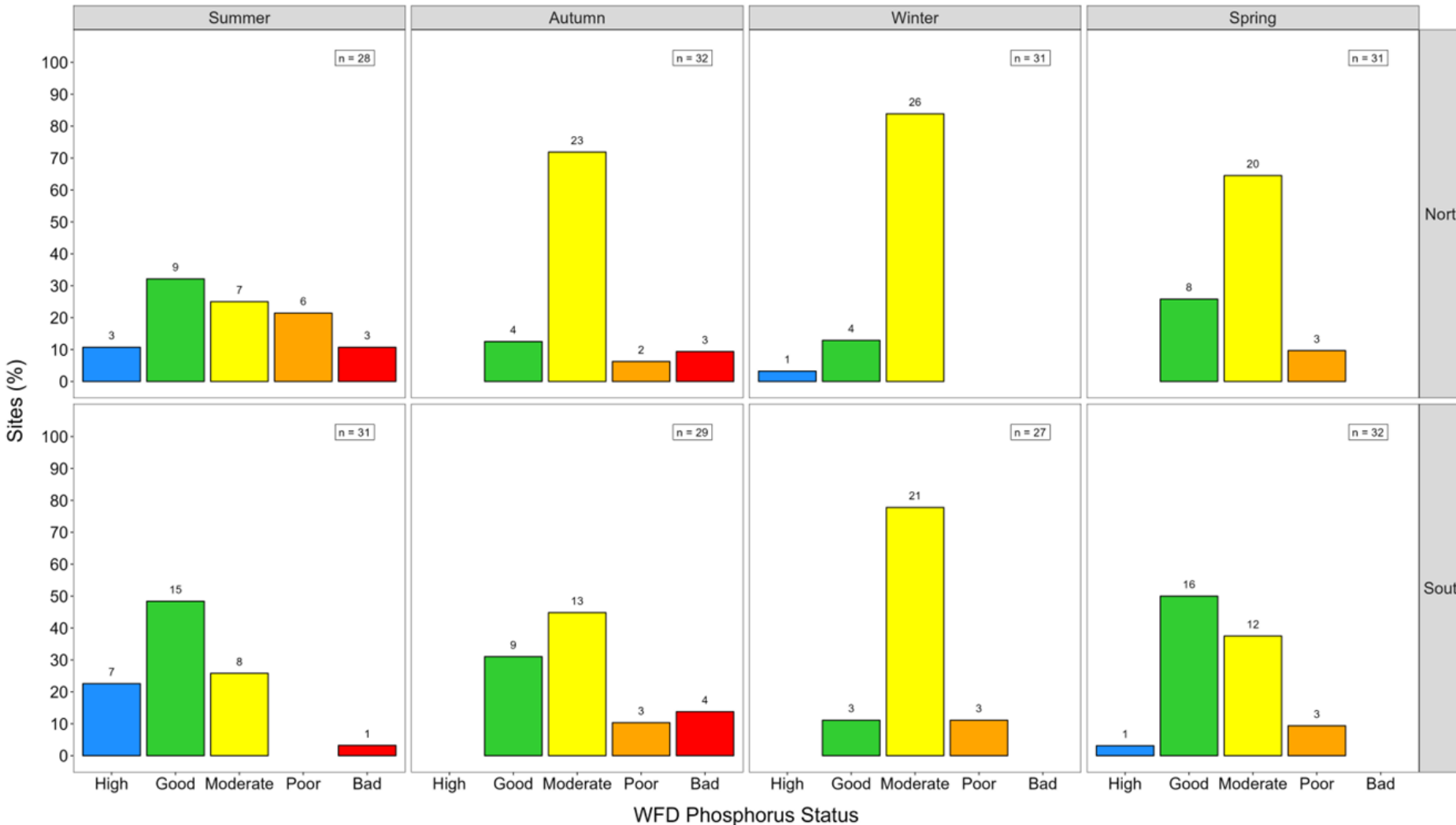


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Visit the FBA website to sign up for the next survey and find out more

EU Water Framework Directive Phosphorus Status Windermere



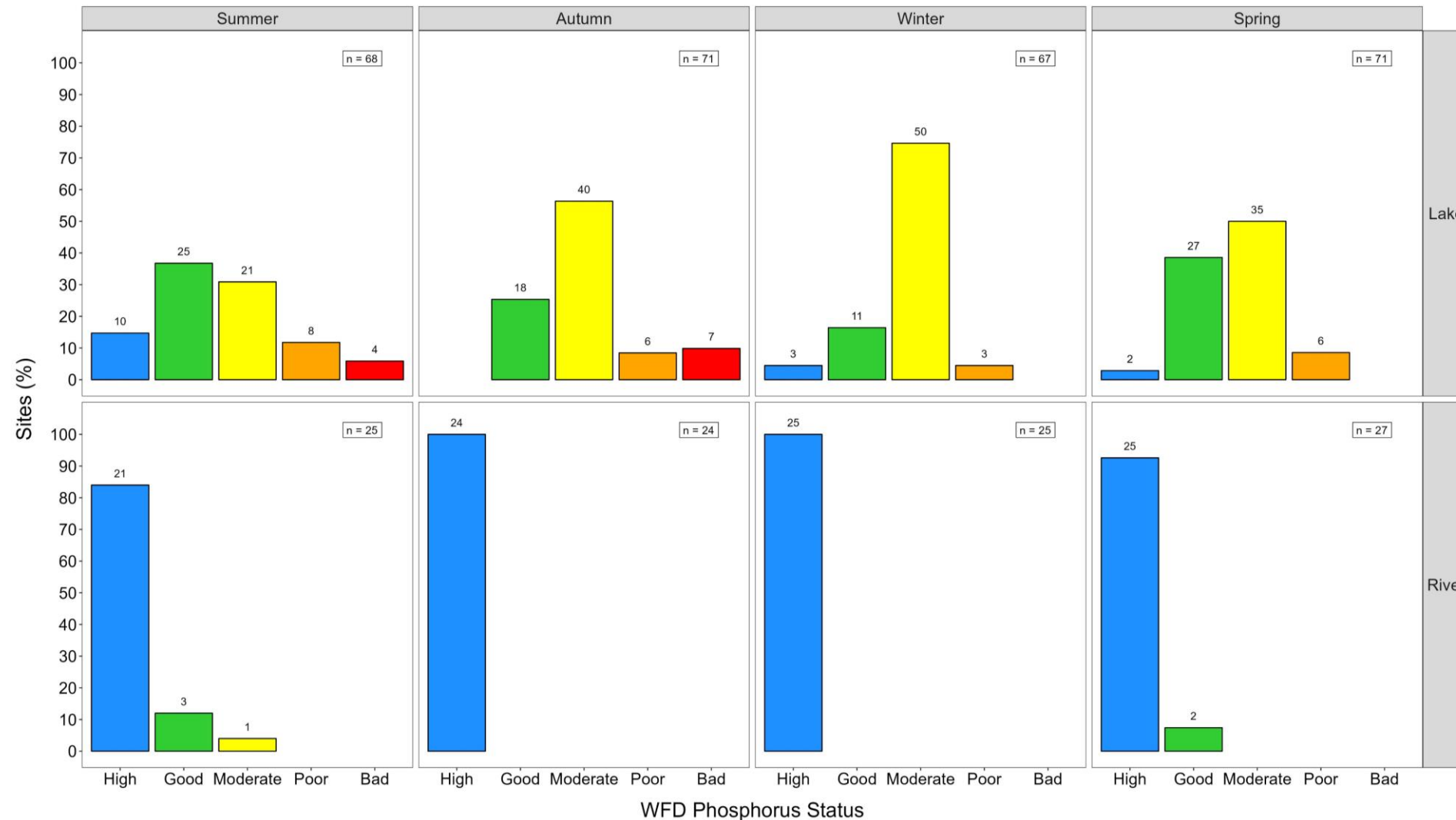
Phosphorus concentrations showed a mixed and seasonally variable picture.

Sites of High status were more common in summer, but low overall.

More sites of Poor and Bad status were seen in summer and autumn, and more sites of Moderate status were seen in autumn and winter, particularly in the North Basin.

EU Water Framework Directive Phosphorus Status

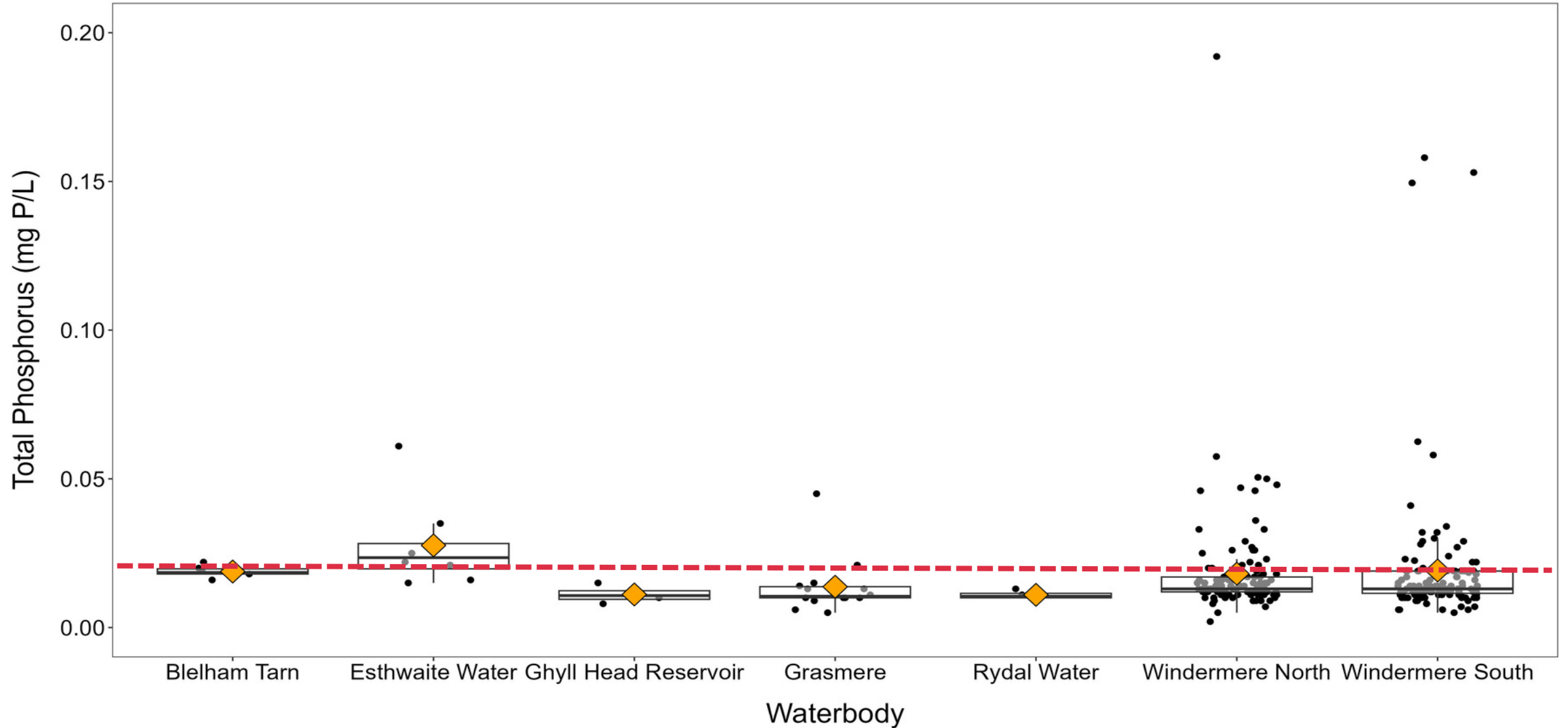
All sites



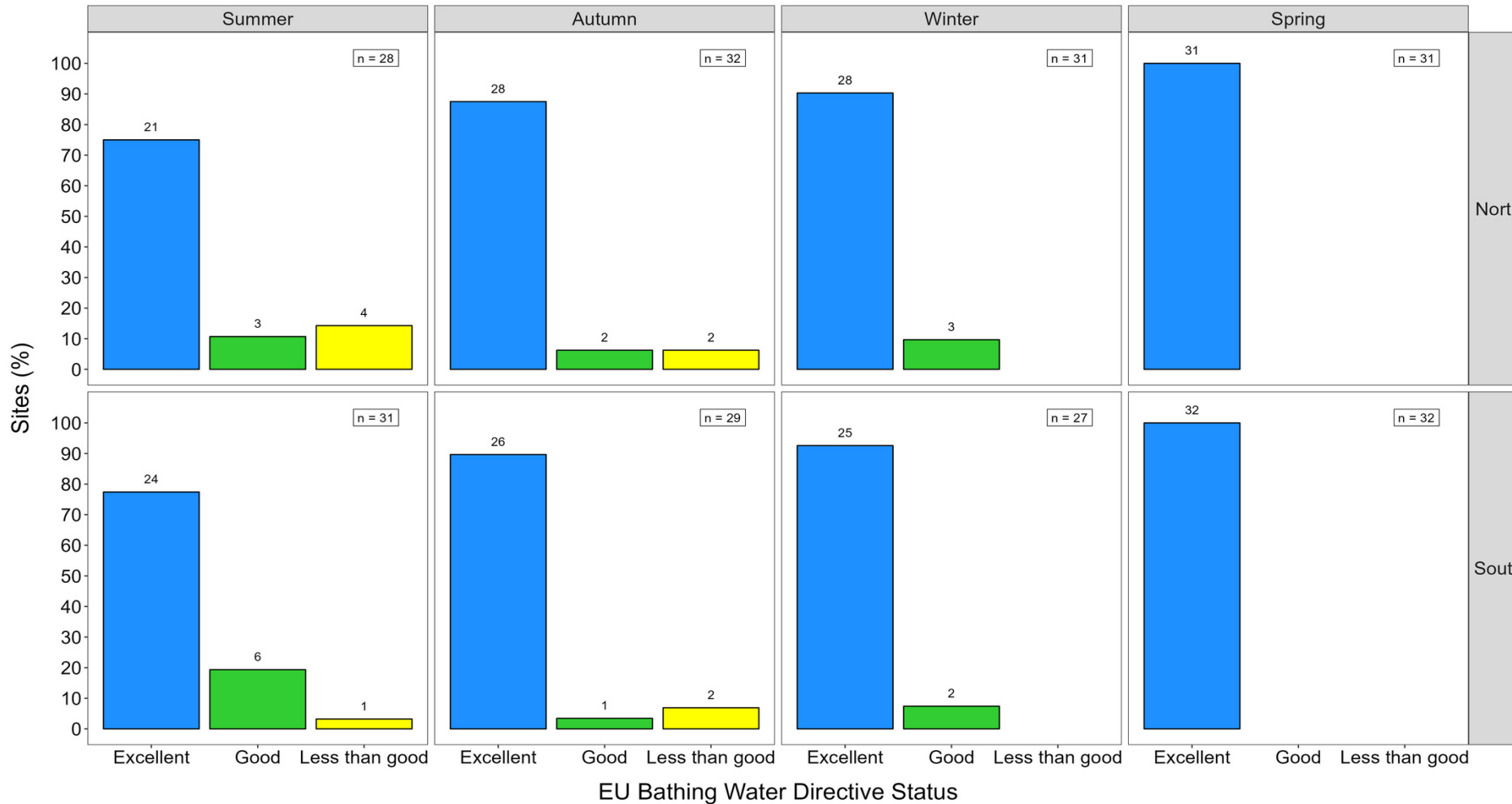
Most river sites consistently met standards for High or Good phosphorus status.

More lake sites met standards for High or Good status in summer and spring. Increasing dominance of sites with Moderate status seen in autumn and winter.

Windermere is not alone...



EU Bathing Water Directive Windermere

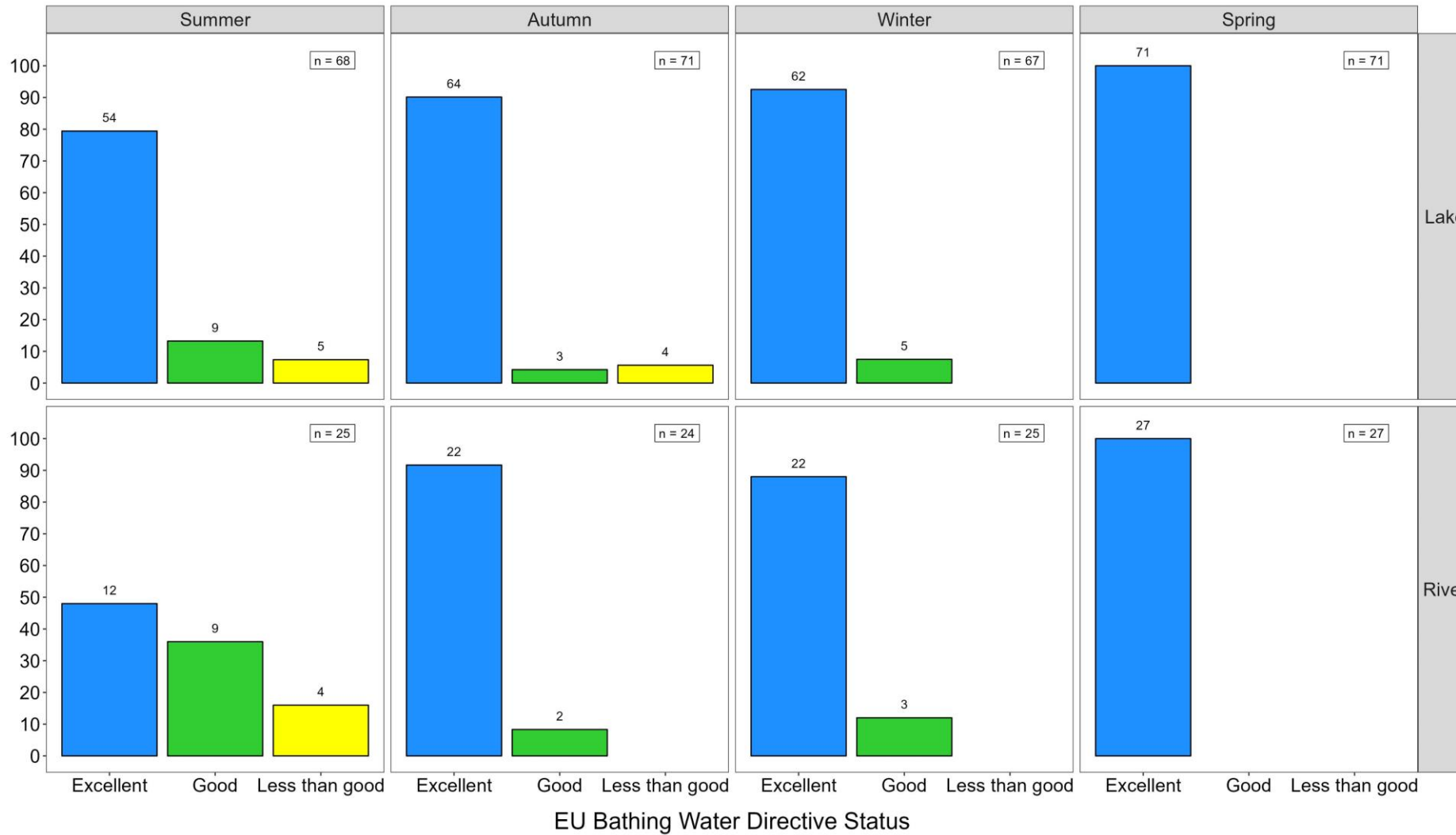


The majority (>80%) of sites were consistent with Excellent or Good status in summer and autumn.

All sites were consistent with standards for Excellent or Good status in winter and spring.

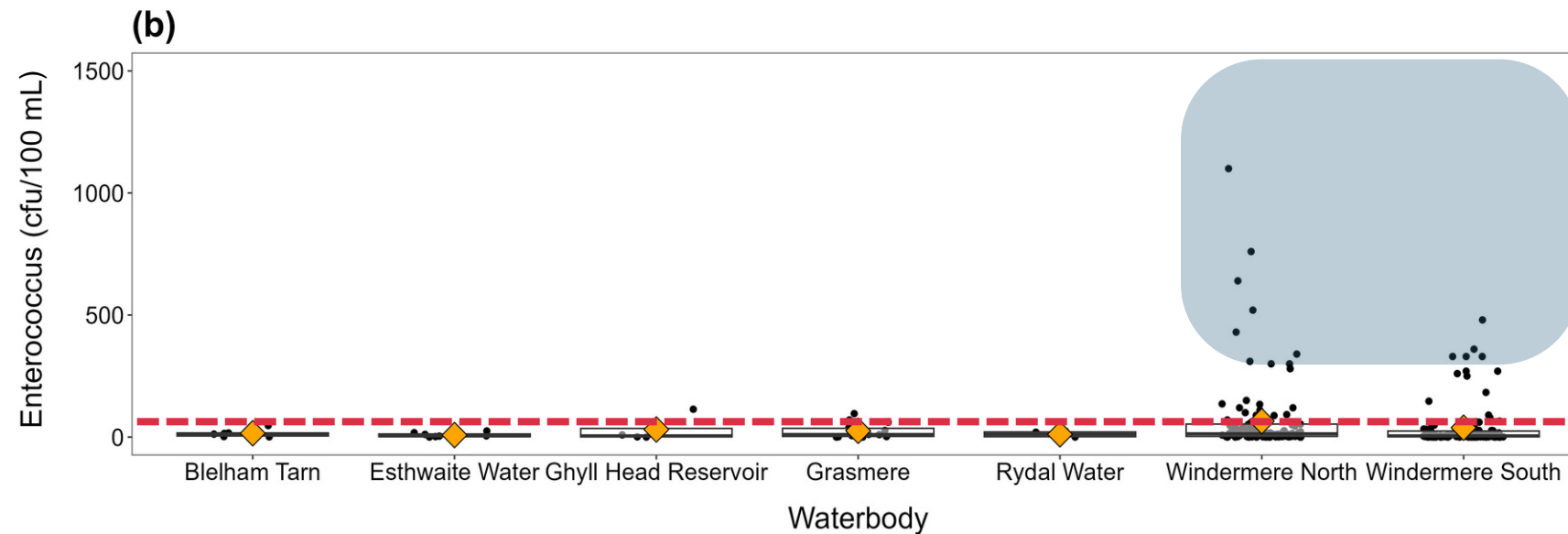
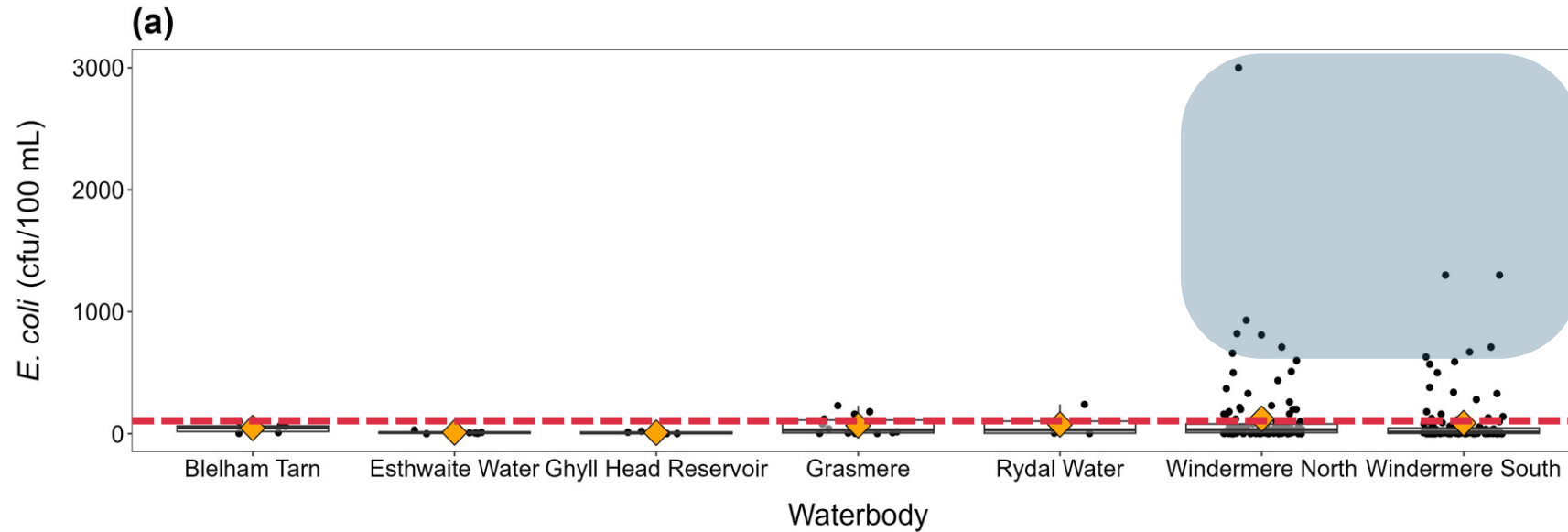
EU Bathing Water Directive

All sites



Findings are similar when all lakes and rivers are considered.

Windermere may be faring worse...



Ecologically dead?



Biodiversity insights



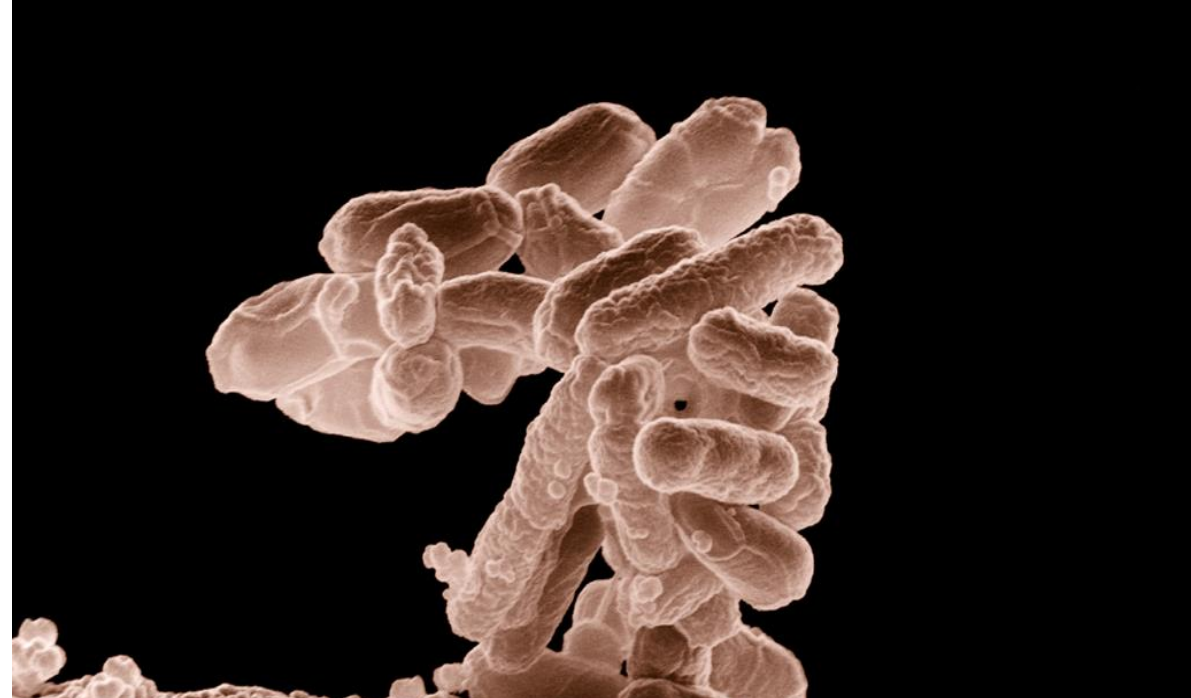
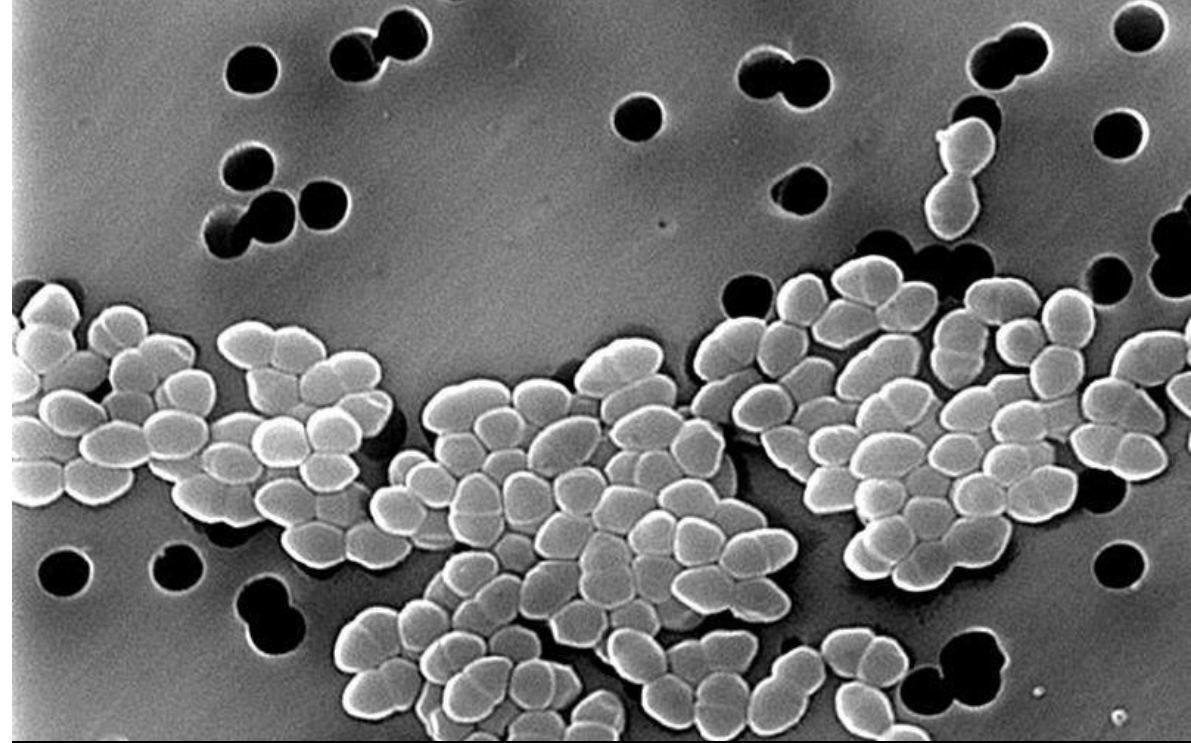
Key findings: phosphorus

- Phosphorus concentrations in Windermere are widely above target levels.
- Phosphorus comes from many sources. Wastewater is one significant source, but only one among a number.
- Other lakes in the catchment (and nationally and globally) face similar challenges.
- Controlling issues such as cyanobacterial blooms will require understanding and action focussed on nitrogen, not just phosphorus.



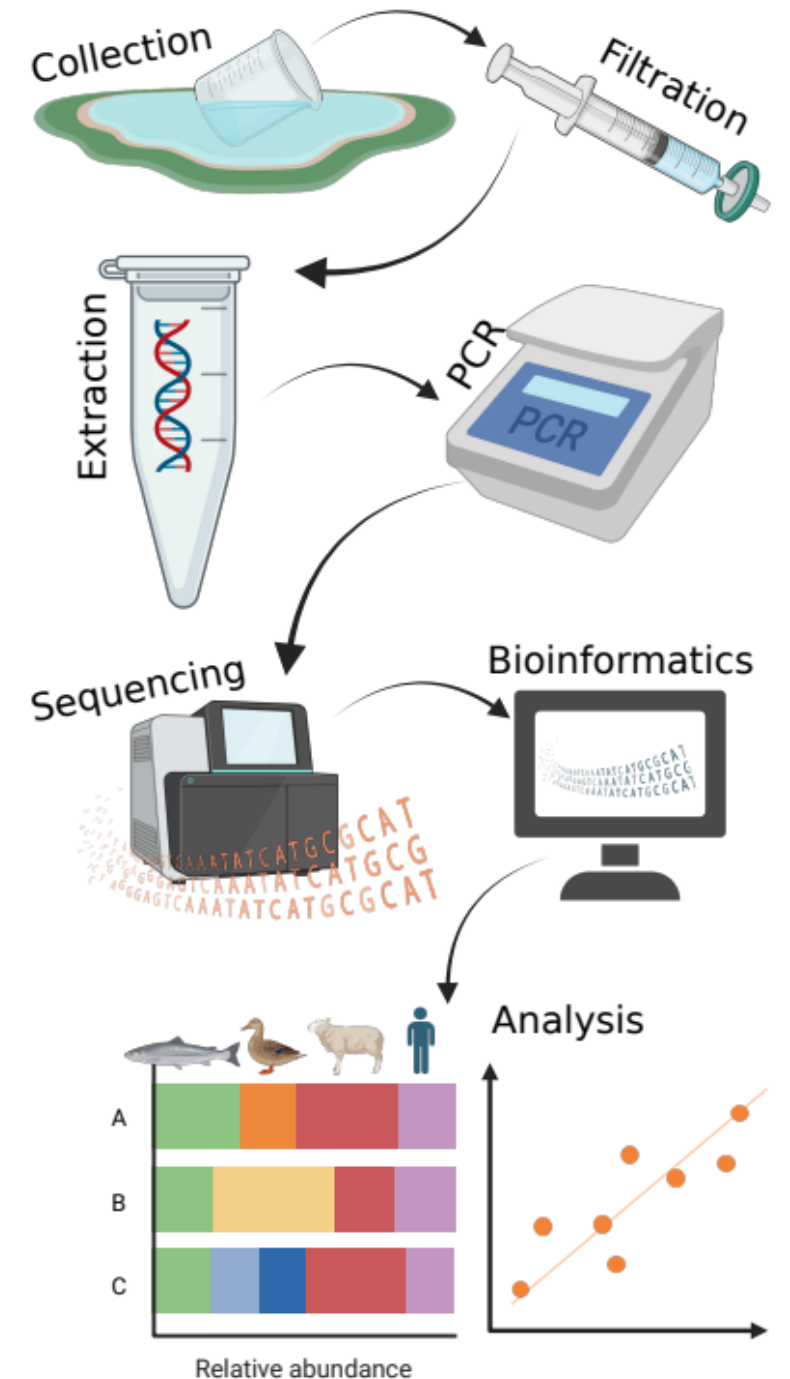
Key findings: bacteria

- Concentrations of bacteria in the majority of samples, including from Windermere, were low in all seasons.
- However, some sites in some seasons do see much higher concentrations, particularly within Windermere.
- The survey suggests that summer and autumn are times when higher bacterial concentrations are seen.



Key findings: biology

- This small survey highlights the biodiversity in Windermere and the wider Leven catchment and the importance of protecting this iconic lake.
- Further eDNA surveys could help to understand trends in biodiversity of Windermere, including the non-vertebrate species that also depend on it, and contribute to understanding the health of the lake.
- eDNA signals may be able to inform understanding of sources and distribution of faecal pollution.



Positive impacts

- Unrivalled spatial dataset describing water quality in the Leven catchment.
- Hotspots of poorer water quality identified, supporting action to address these, e.g. Stock Ghyll in Ambleside, River Brathay around Skelwith Bridge.
- New analyses are extending the scope of the survey, such as eDNA metabarcoding.
- Created a platform supporting year-round engagement with local community.
- This has involved over 450 citizen scientists and hub staff (225 volunteer days).
- Volunteers span ages from under 10 to over 90 - scope to engage current and future generations in understanding Windermere.



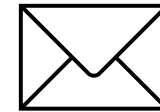
Next steps

- Summary of and technical report on first year of survey data.
- Engagement and communication activities focused on the first year of the survey.
- Two more surveys confirmed in November and February.
- Community and scientific benefits rely on continuation of the survey over the longer-term.
- Commitment to an annual funding model would support a more strategic approach, enabling maximum benefits from the Big Windermere Survey.



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Questions?



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#BigWindermereSurvey



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