

Loch Leven water quality monitoring update

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Water quality problems 1980s and 1990s



Toxic bloom turns loch into a shallow grave

Loch Leven is green with algae and might be warning signs, Jeremy Watson, Environment Correspondent, examines the problem and possible solutions.

THE POISONING OF LOCH LEVEN

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The water, which is green with algae, is a warning sign of a problem. The water is green with algae and might be warning signs, Jeremy Watson, Environment Correspondent, examines the problem and possible solutions.

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Cost of 'Scum Saturday' to local community ~ £1M in 1992



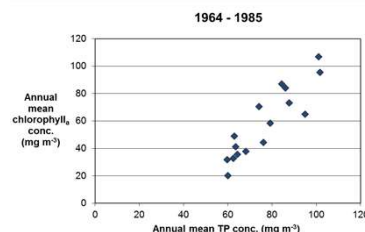
Understanding cause and effect

Eutrophication causes water quality problems.

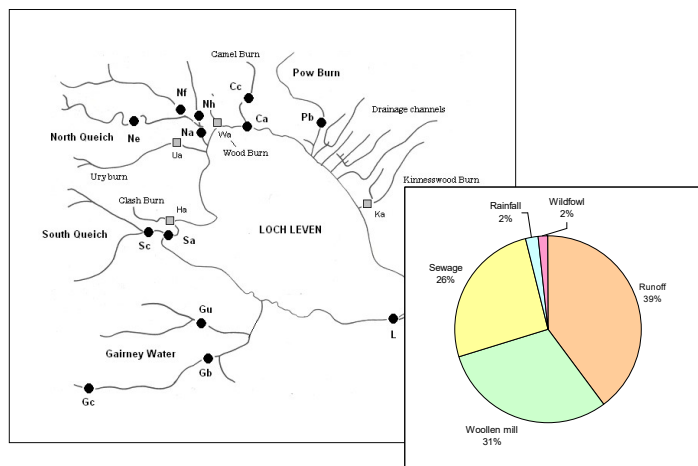
These include:

- toxic algal blooms.
- reduced amenity value
- increased water treatment costs

Long term monitoring data (1968-1985) showed P availability to be the main problem.



Identifying catchment sources

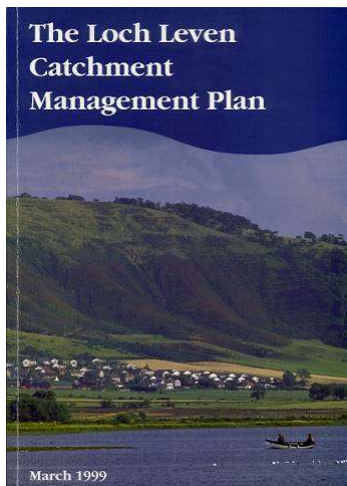


P input measured every 8 days for 1 year, 1985

Bailey-Watts & Kirika, 1987



Restoration targets set



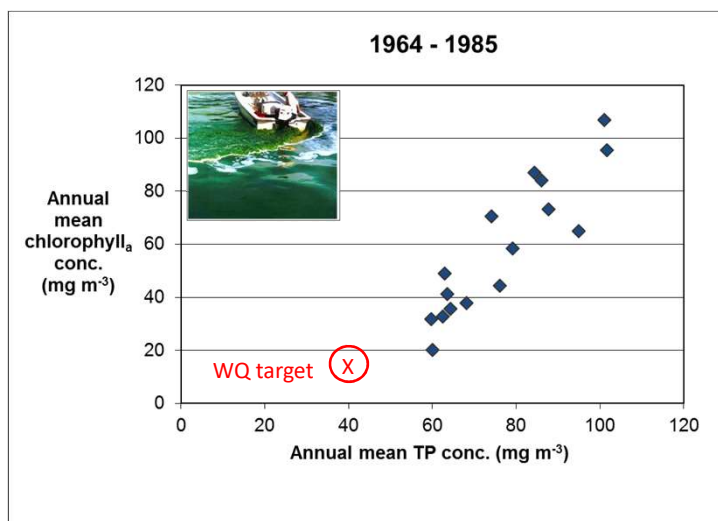
Indicators	Target values	Actual values
Annual mean P conc. (mg m ⁻³)	40	75
Annual mean chlorophyll conc. (mg m ⁻³)	15	34
Annual mean water clarity (m)	2.5	1.6
Max. macrophyte depth (m)	4.5	1.5

Estimated P loading capacity = 10.5 t y⁻¹

Actual P loading = 20.5 t y⁻¹



Restoration targets in context



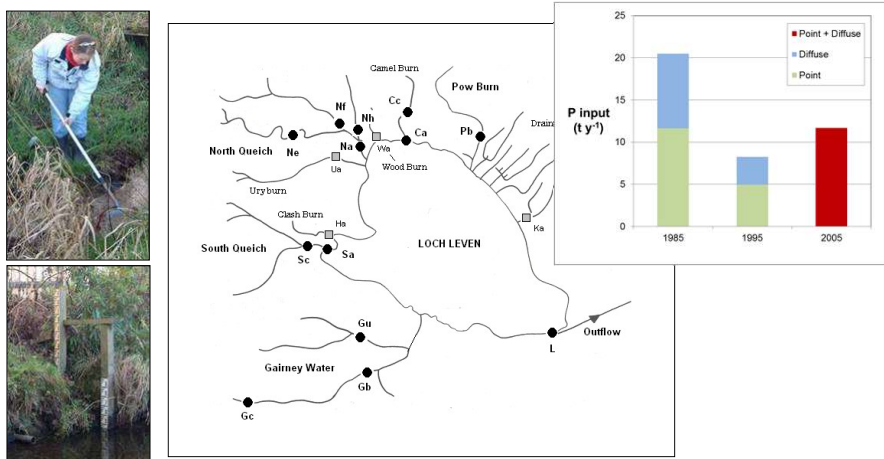
Reducing P inputs



MILNATHORT WASTEWATER TREATMENT PLANT
Cost £2,807,000



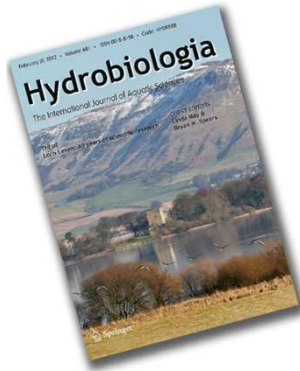
P inputs from catchment reduced by ~50%



P input measured every 8 days for 1 year – 1985, 1995, 2005



Better news by 2012!



Loch is booming after big blooming clean-up

REBECCA MCDERMID

LOCH Lomond is fertile but was once known for the algae blooms that thickened its clear waters. It got so badly choked with green algae last year, causing a major spill and leading to questions in parliament.

Now however the loch's water quality is the best it has been in more than 20 years, according to a report commissioned by Scottish Natural Heritage.

Both fish and bird life have benefited. From the greatly improved clarity of the water and the absence of algal blooms of almost any kind.

Scotland's largest lowland loch is naturally important for its watershed and has the UK's largest population of inland breeding ducks, as well as thousands of migratory birds.

SNH reports that pochard ducks, which nest and winter in the loch, have increased in number to Loch Lomond from 1000 wintering birds in 1990 to 1000 in 2011. The loch was thought to be one of the most important of waterfowl places.

Loch Lomond's fishery, which was last declared in the 1990s due to the pollution, is also improving. Last September, Michael MacIntyre of East Lothian landed the largest brown trout ever caught in Loch Lomond.

James Montgomery of ERM, who conducted the report for CEH, has monitored the water quality at the loch for 10 years.

"In the 1970s, we had lots of nasty blooms and the water wasn't very clear, but it's already becoming clearer."

"The long term monitoring programme has given us a good understanding of the links between pollution, climate change and ecological response and this has ultimately led to better water quality. We need to make sure we continue to protect the good water quality we've got in Loch Lomond."

He said: "In 1970, we had lots of nasty blooms and the water wasn't very clear, but it's already becoming clearer."

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THE HERALD WEDNESDAY 27.06.2012



FFRHS Ecologist Dr Linda May and businessman James Montgomery take samples from Loch Lomond that show the improved water quality following the algae problem back in 2010. Michael MacIntyre with the largest brown trout he has caught in the loch in 20 years. (The Herald)

water clarity was reduced to a depth of 10 metres.

It deterred visitors, as signalled by the number of people visiting the loch for fishing and water sports.

Scottish Natural Heritage has been made to reduce phosphorus levels and the water clarity can now reach 4 to 5 metres.

Measurements included installing phosphorus scrubbing facilities on the loch's outflow. These waste water treatment works, preventing better agricultural practices and other controls on private waste water treatment systems.

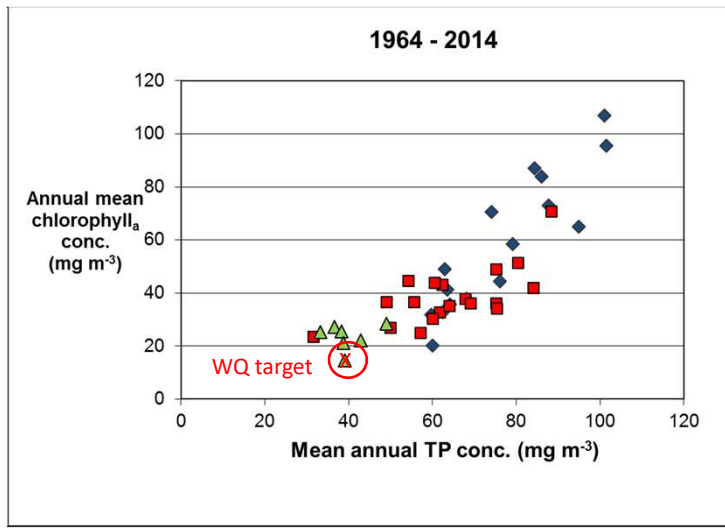
Due to a fall in the number of people visiting the loch for fishing and water sports.

Scottish Natural Heritage has been made to reduce phosphorus levels and the water clarity can now reach 4 to 5 metres.

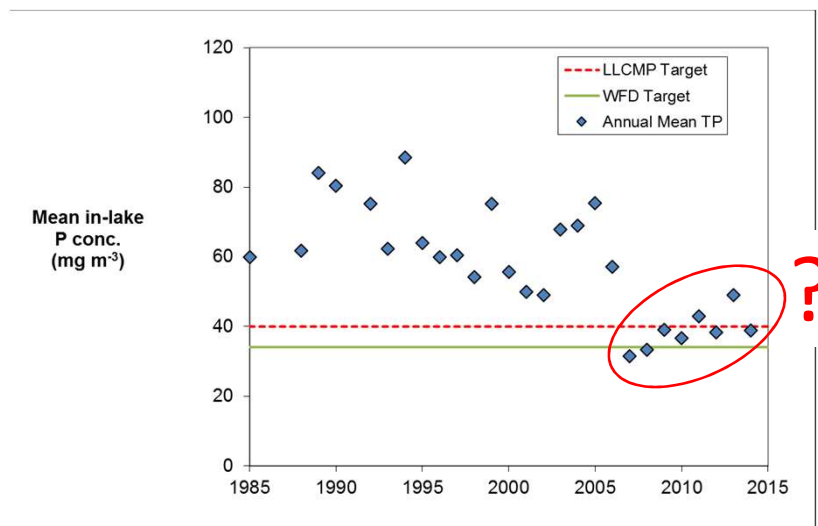
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Recovery trajectory



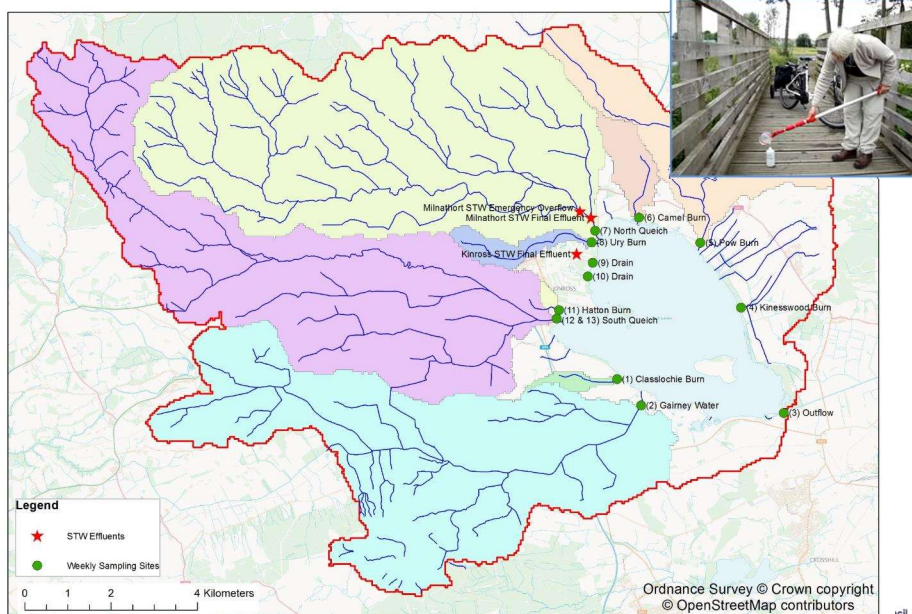
Response of in-lake P concentrations



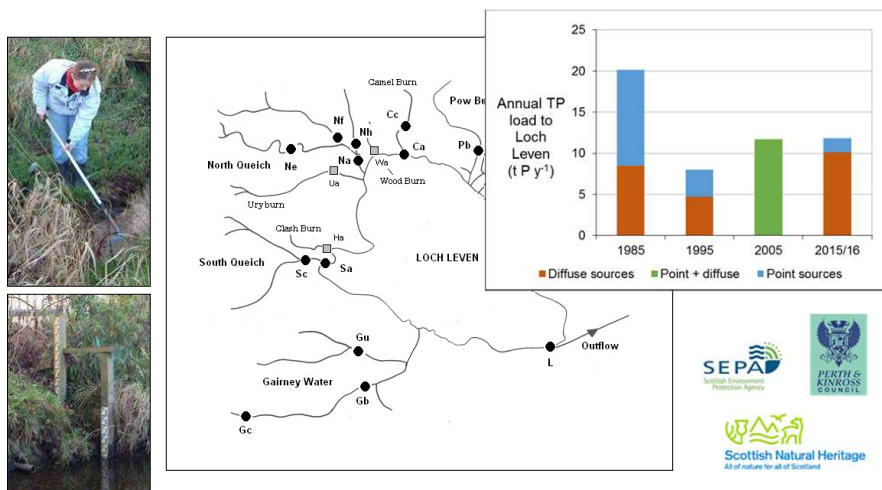
Nutrient loading study 2015/16

- To re-assess phosphorus and nitrogen inputs to Loch Leven
- Co-funded by SNH, SEPA, CEH & P&KC
- Start date July 2015
- Finish date March 2017

Water sampling sites chosen



P input (load) to the lake

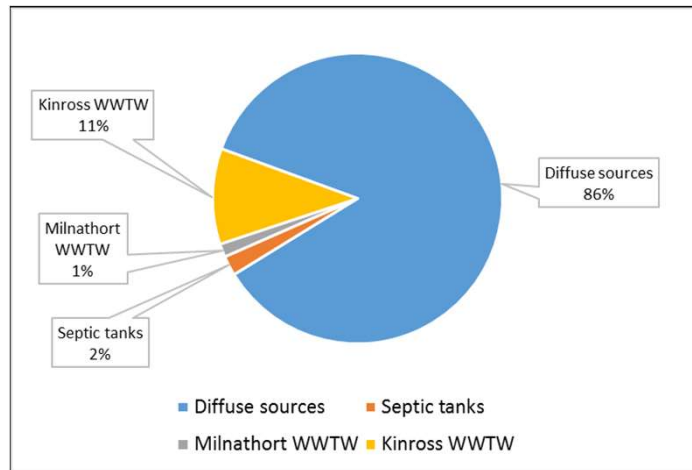


P input measured every 7-8 days during 1985, 1995, 2005 & 2015/16

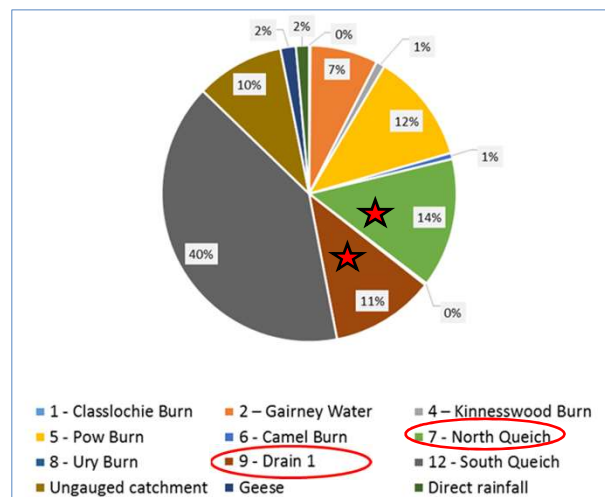
Bailey-Watts & Kirika, 1987, 1999; Defew 2008; May et al. 2017



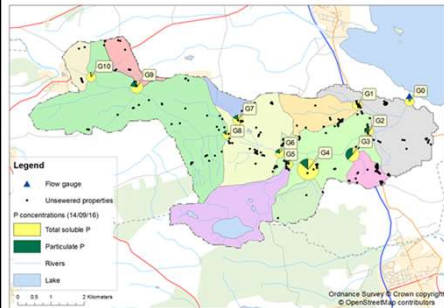
Source apportionment of P input, 15/16



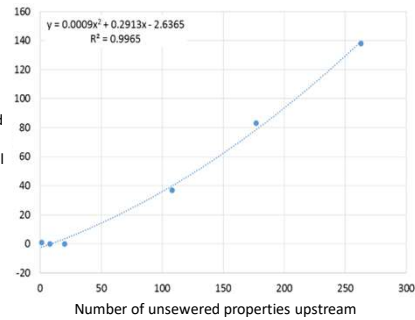
Source apportionment of P input, 15/16



P losses from septic tanks

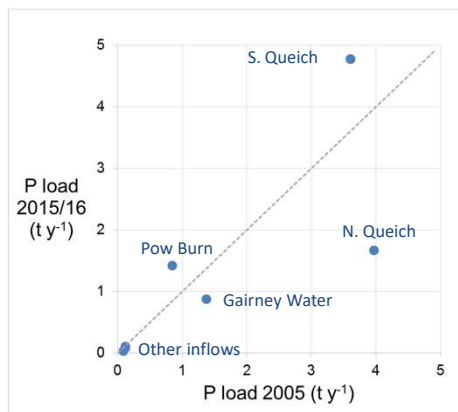


Estimated P input from rural point sources (kg y⁻¹)

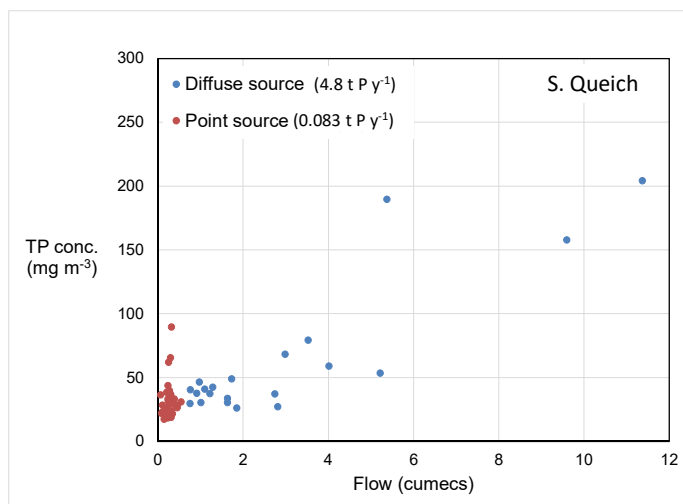


- P loss to water per property is about 0.47 kg P y⁻¹
- This equates to a P load of about 0.45 t P y⁻¹ to the loch from all unsewered systems

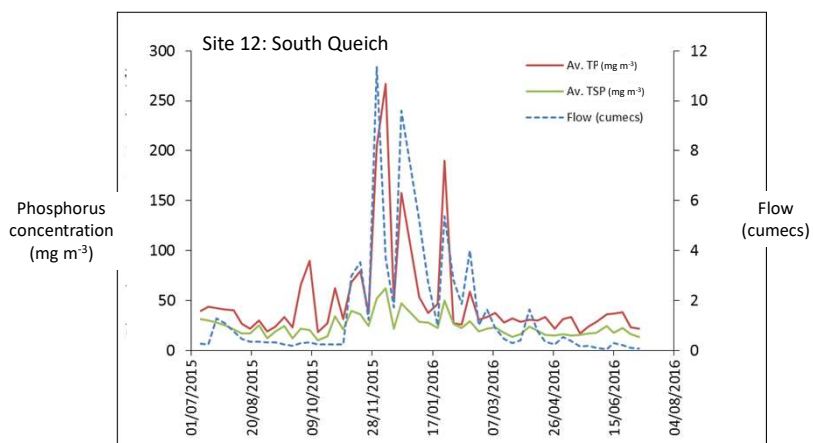
Changes in P inputs, 2005 *cf.* 2015/16



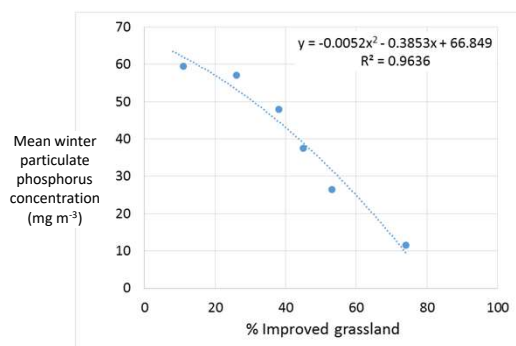
Source apportionment: South Queich



Storm events transport particulate P to loch



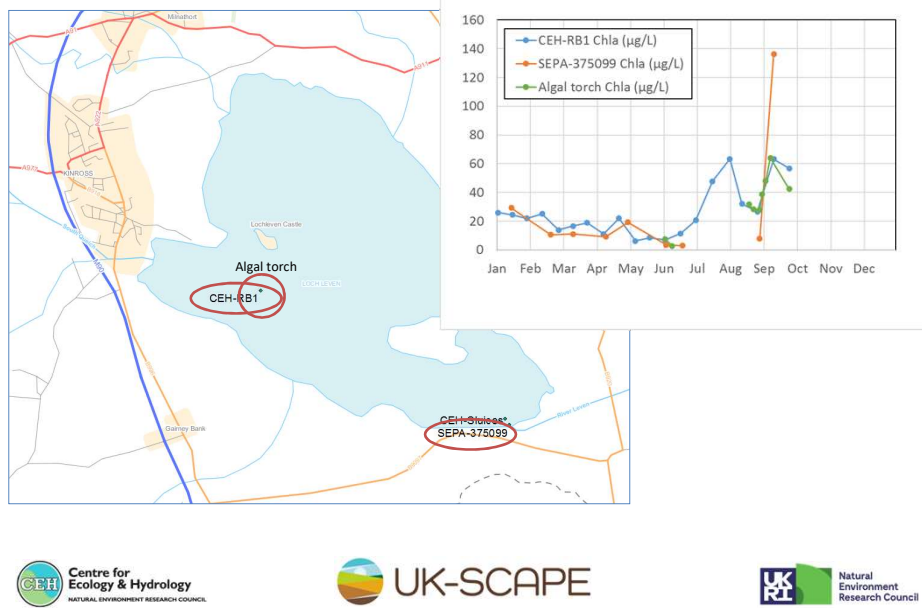
Land use affects diffuse pollution



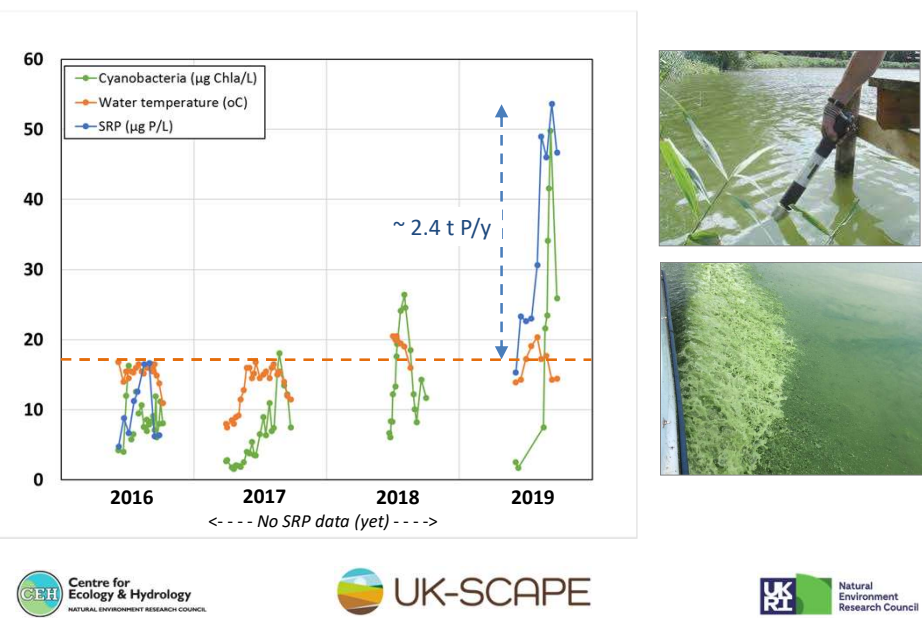
WHY ALGAL BLOOMS IN 2018 AND 2019?

Evidence so far...

Comparison of results from different sources



Cyanobacteria high when temperature >17°C



Conclusions

- Loch Leven appears to be becoming more eutrophic.
- Probably due to internal P release from sediments.
- No evidence (so far) of overall increase in inputs from the catchment.
- But the balance of point to diffuse sources has changed.
- Controlling diffuse sources is key to maintaining or improving water quality in the loch.
- Changing the flushing regime might help.
- But, climate change isn't helping:
 - heavy rainfall events are increasing nutrient runoff
 - rising temperatures are promoting algal blooms



Stakeholder involvement

SEPA Scottish Environment Protection Agency

NFU Scotland

rspb

UCL

SRUC

Environmental Change Network

nature.scot

Kintross estate

Scottish Water Always serving Scotland

The James Hutton Institute

UNIVERSITY OF DUNDEE

PERTH & KINROSS COUNCIL

EUROPEAN UNION

LOCH LEVEN FISHERIES

The Loch Leven Catchment Management Plan

UNIVERSITY OF STIRLING

DIAGEO

Lockett AGRI-ENVIRONMENTAL DINGWALL | PERTH

WILLIAM GRANT FOUNDATION

marine.scotland

The Scottish Government

HERIOT WATT UNIVERSITY

CONSERVATION CENTRE

SCOTFWAG Scottish Farming and Wildlife Advisory Group

CEH Centre for Ecology & Hydrology

UK-SCAPE

Natural Environment Research Council

And many others ...

Acknowledgements

- Tony Bailey-Watts and Alex Kirika for establishing long term monitoring at Loch Leven, 52 years ago
- Kinross Estates for access to the loch & historical records
- NERC, SNH, SEPA, Perth & Kinross Council & William Grant Foundation for co-funding & sharing data
- More than 150 people for their contributions to this project since 1967



Thank you for listening

Any questions?

