Loch Leven, Scotland
a restoration case study

14th October 2025

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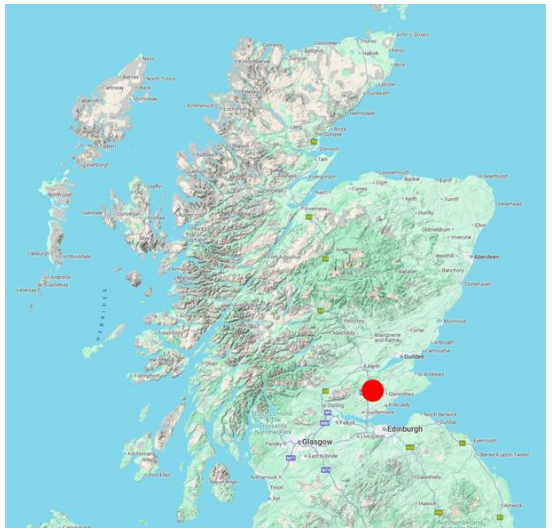
NATIONAL CAPABILITY FOR UK CHALLENGES

FUTURELAKES
For Nature, Climate and People

UK & Ireland
United Kingdom & Ireland Lakes Network

Location and sampling sites



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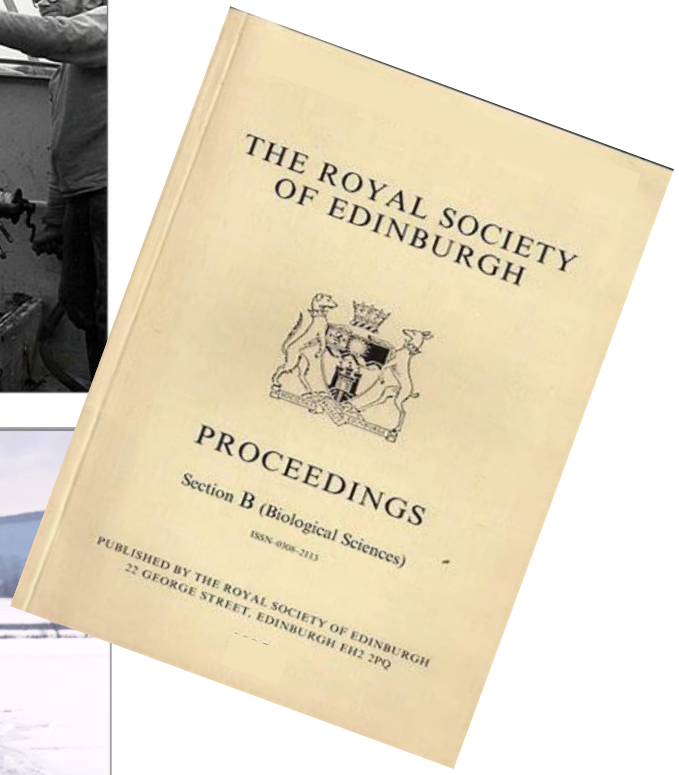
Weekly sampling 1968 - 1974

International Biological Programme (IBP)



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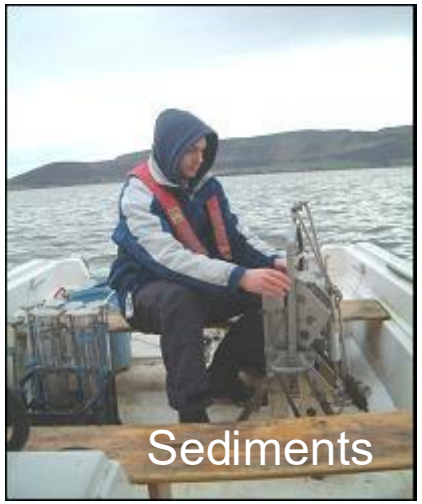
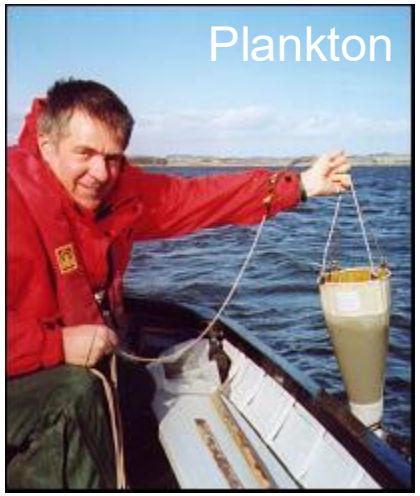
Fortnightly sampling since 1975





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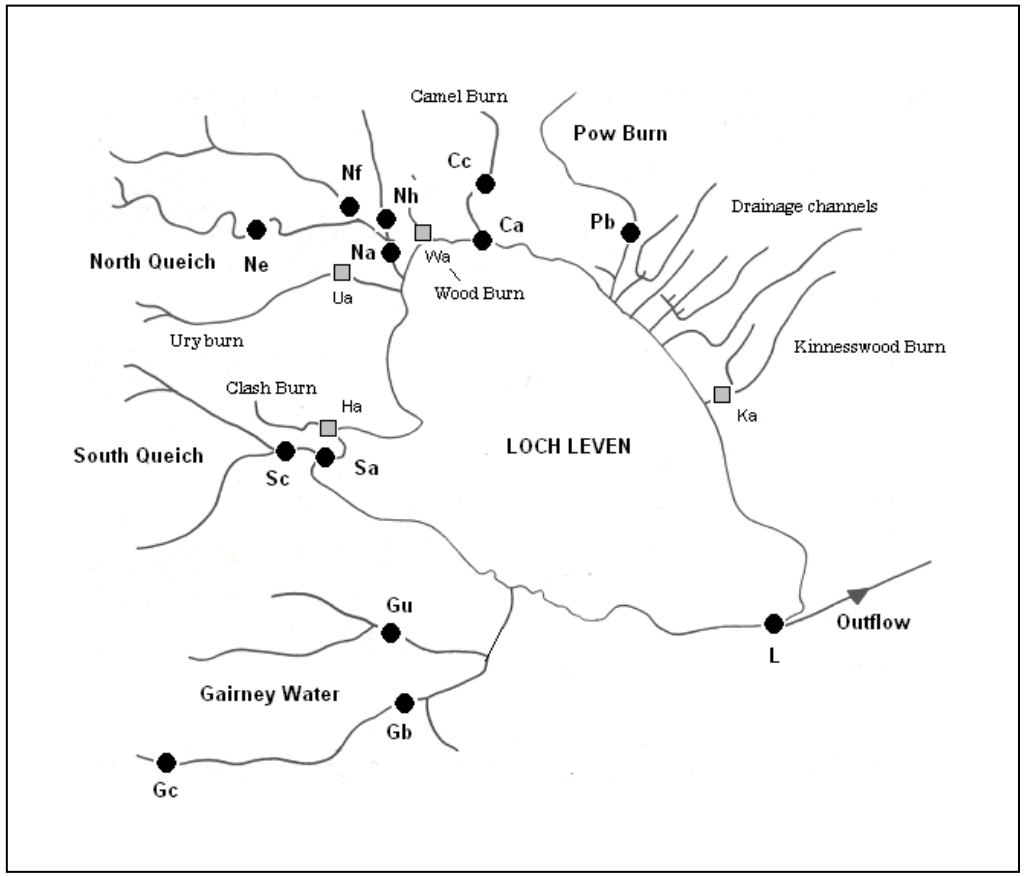
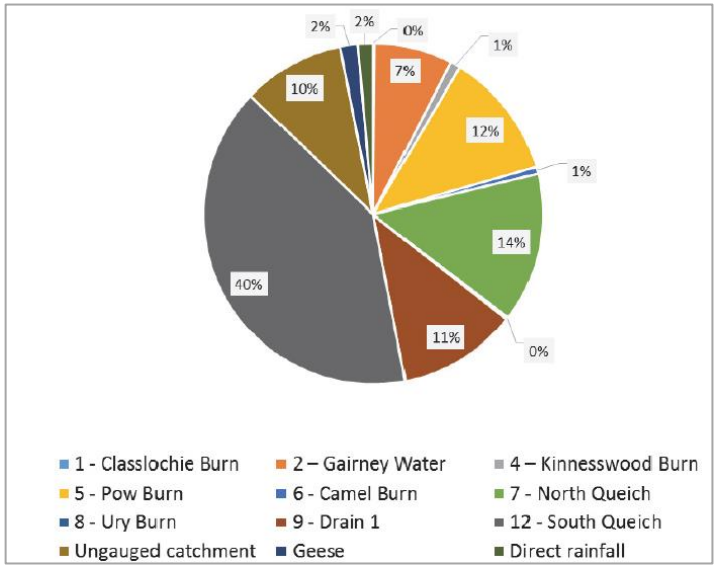
Nutrient source apportionment every 10 years





Nutrient inputs measured every 7-8 days, 1985, 1995, 2005, 2015/16

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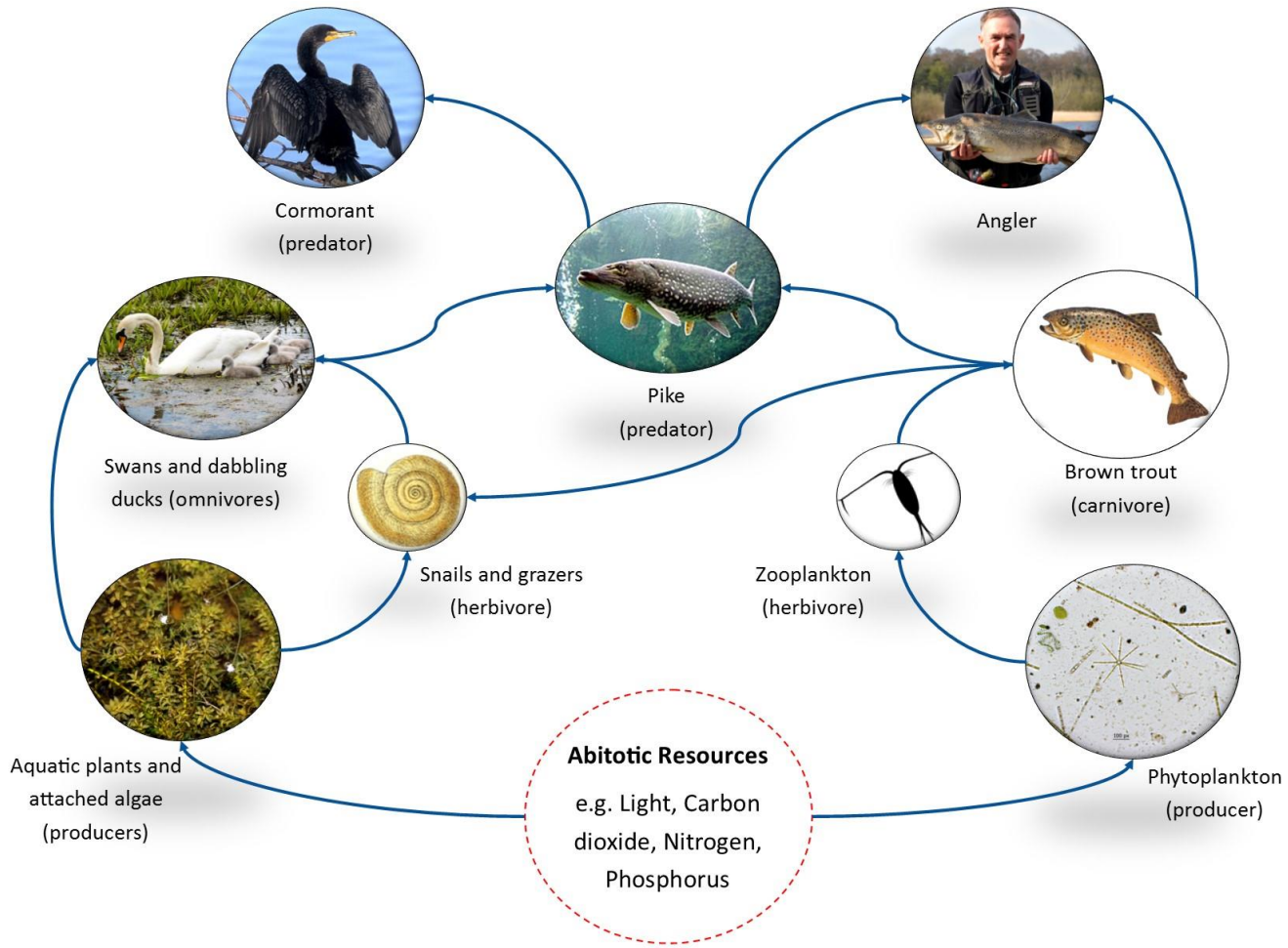
PERTH & KINROSS COUNCIL

NatureScot NàdarAlba

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

Loch Leven food web



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Water quality problems 1980s and 1990s

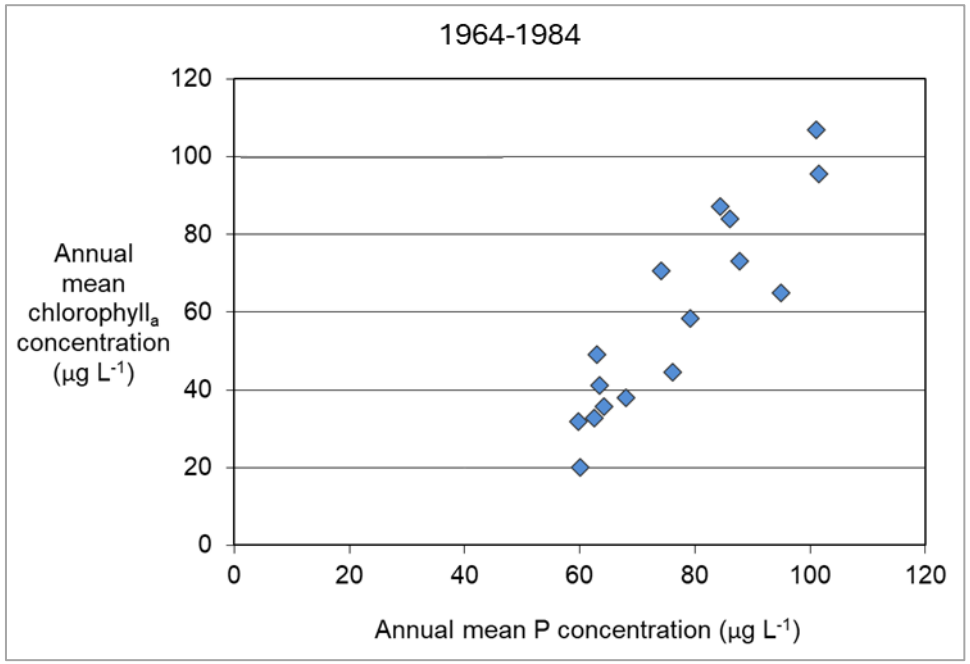
Toxic bloom turns loch into a shallow grave

Loch Leven is green with algae and ringed by warning signs. **Jeremy Watson**, Environment Correspondent, examines the problems and possible solutions

THE POISONING OF LOCH LEVEN

LOCH LEVEN

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



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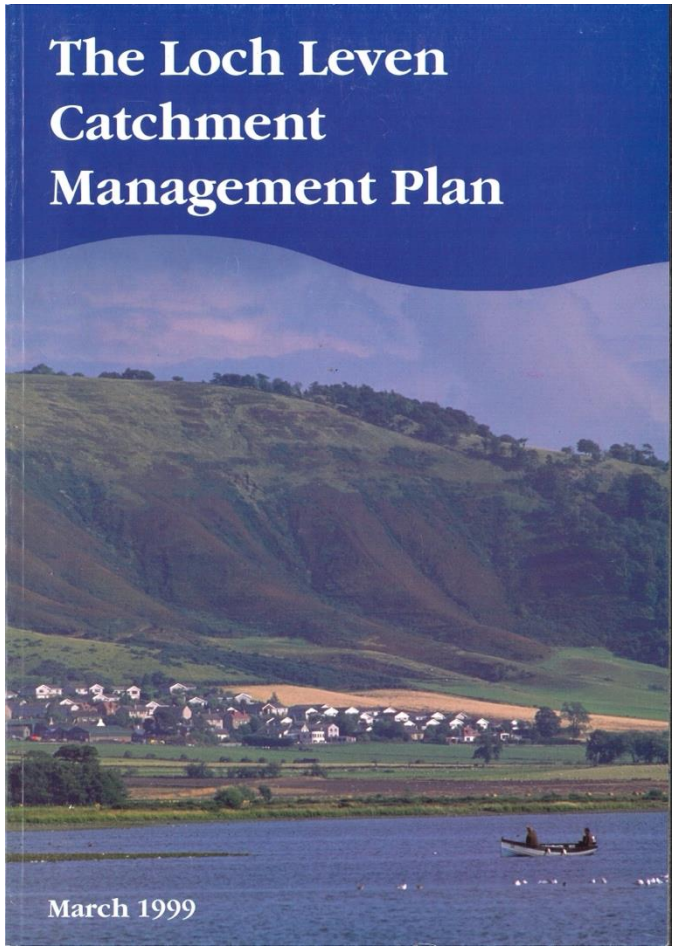
Point sources upgraded, 1987-1997

Action	Dates	Cost	Annual Running Cost	Approximate Phosphorus Reduction (where known)
Todd & Duncan	1970s - 1987	Unobtainable	Not Applicable	6.29 tonnes
Kinross WWTW upgrade by TRC (including installation of phosphorus-stripping)	1993	£75,000	Unobtainable	1.7 tonnes
Installation of new ferric sulphate dosing plant at Kinross by ESW	1997	£25,000	£15,000	0.4 tonnes*
Completion of new Milnathort WWTW by TRC	1995	£2.8m	Unobtainable	0.59 tonnes
Installation of new ferric sulphate dosing plant at Milnathort by ESW	1999/2000	£25,000	£5,000	Improved reliability and operation
Diversion of Kinnesswood's sewage to the Leven Valley Trunk Sewer by ESW	1997	£1.2m	Unobtainable	0.55 tonnes
First Buffer Strip Initiative, using set-aside payments and private arrangements of individual farmers	1995	Unknown	Unknown	Unknown
Vane Farm	1997	£13,000	Unobtainable	41kg**
Quantifiable Totals		£4.1m+	£20,000+	ca. 9.6 tonnes***



- *P input reduced by ca. 9.6 t p.a. (50%)*
- *Total cost > £4.1M*

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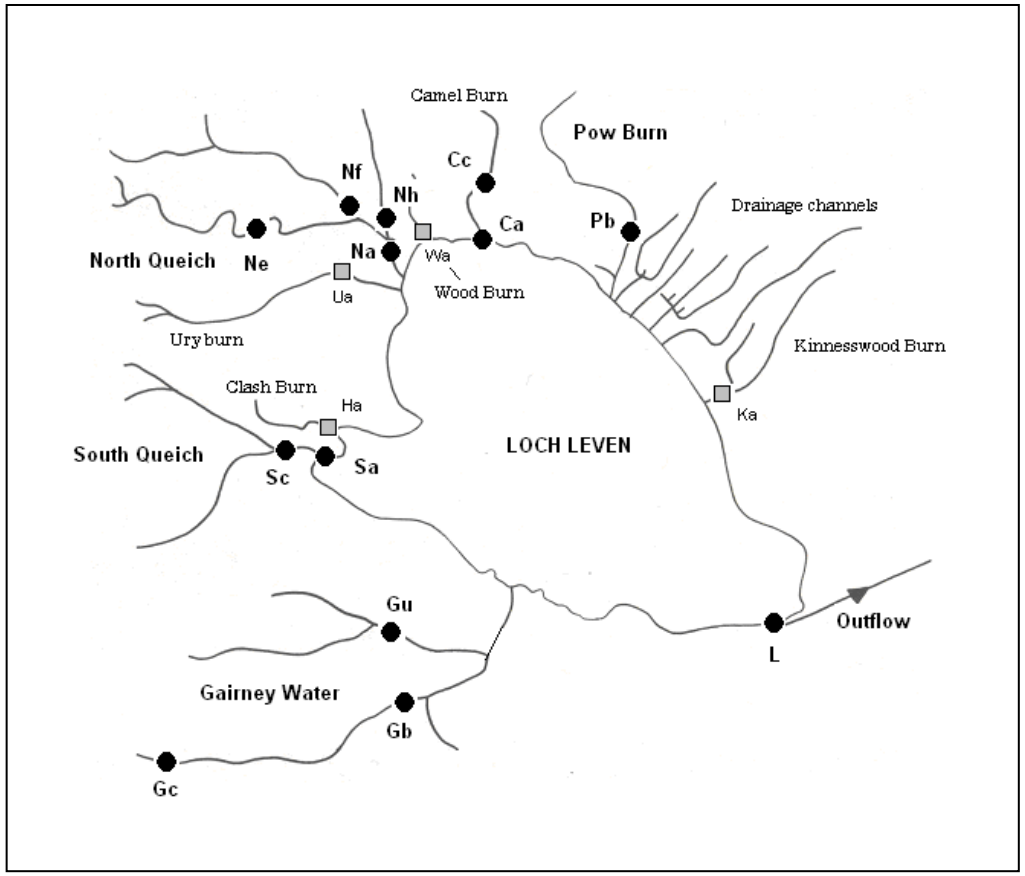
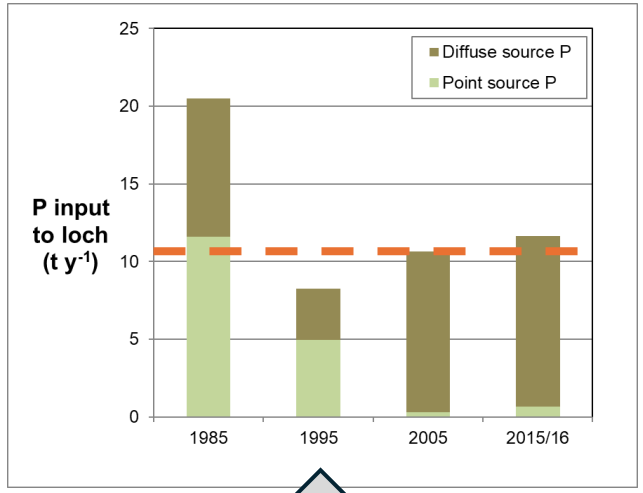
Impact on P inputs





Dry spring/ summer

Target set by LLCMG

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NatureScot Scotland's Nature Agency Buidheann Nàdair na h-Alba

SEPA Scottish Environment Protection Agency

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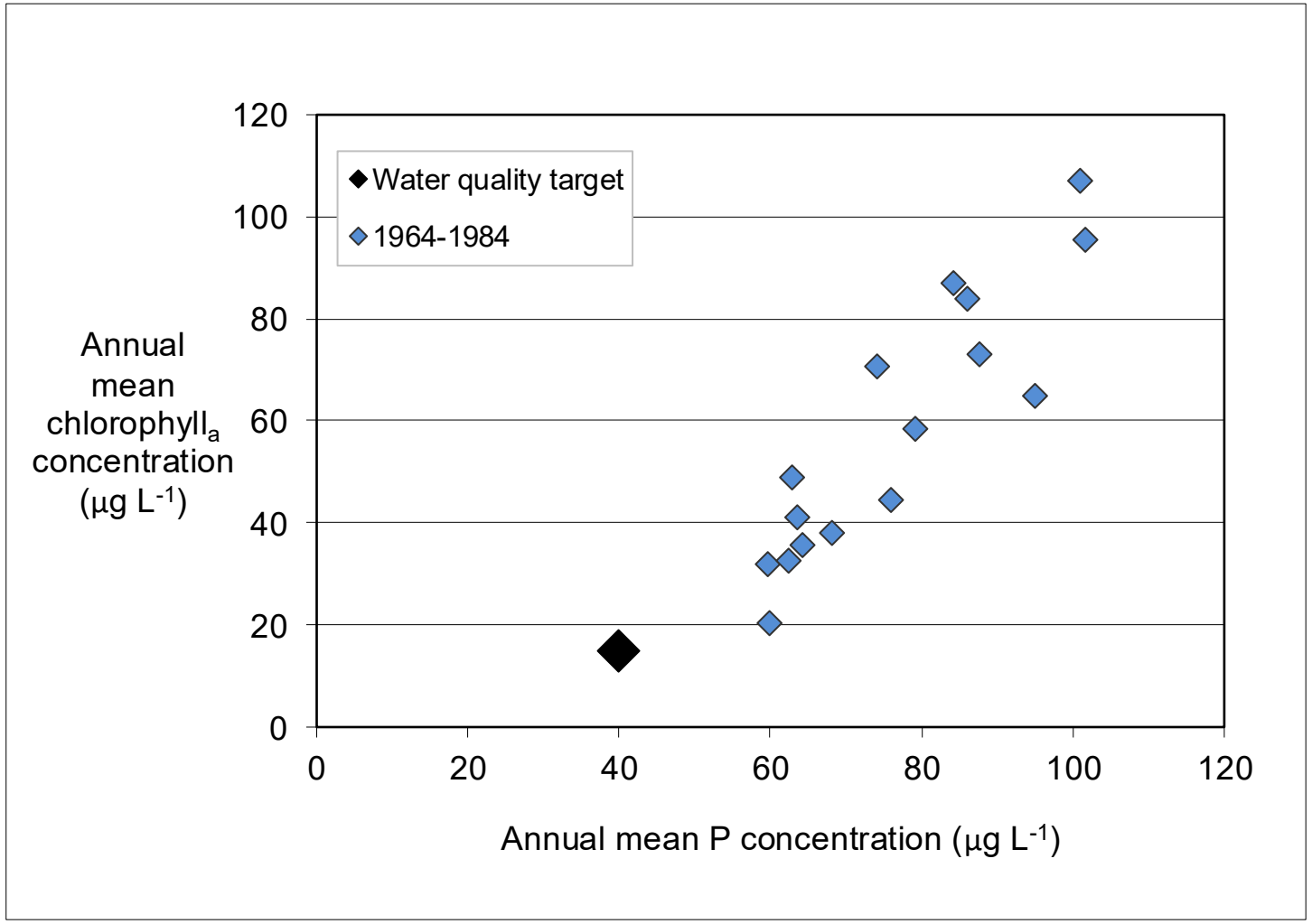
Bailey-Watts & Kirika, 1987, 1999; Defew 2008; May et al. 2017

Impact on water quality



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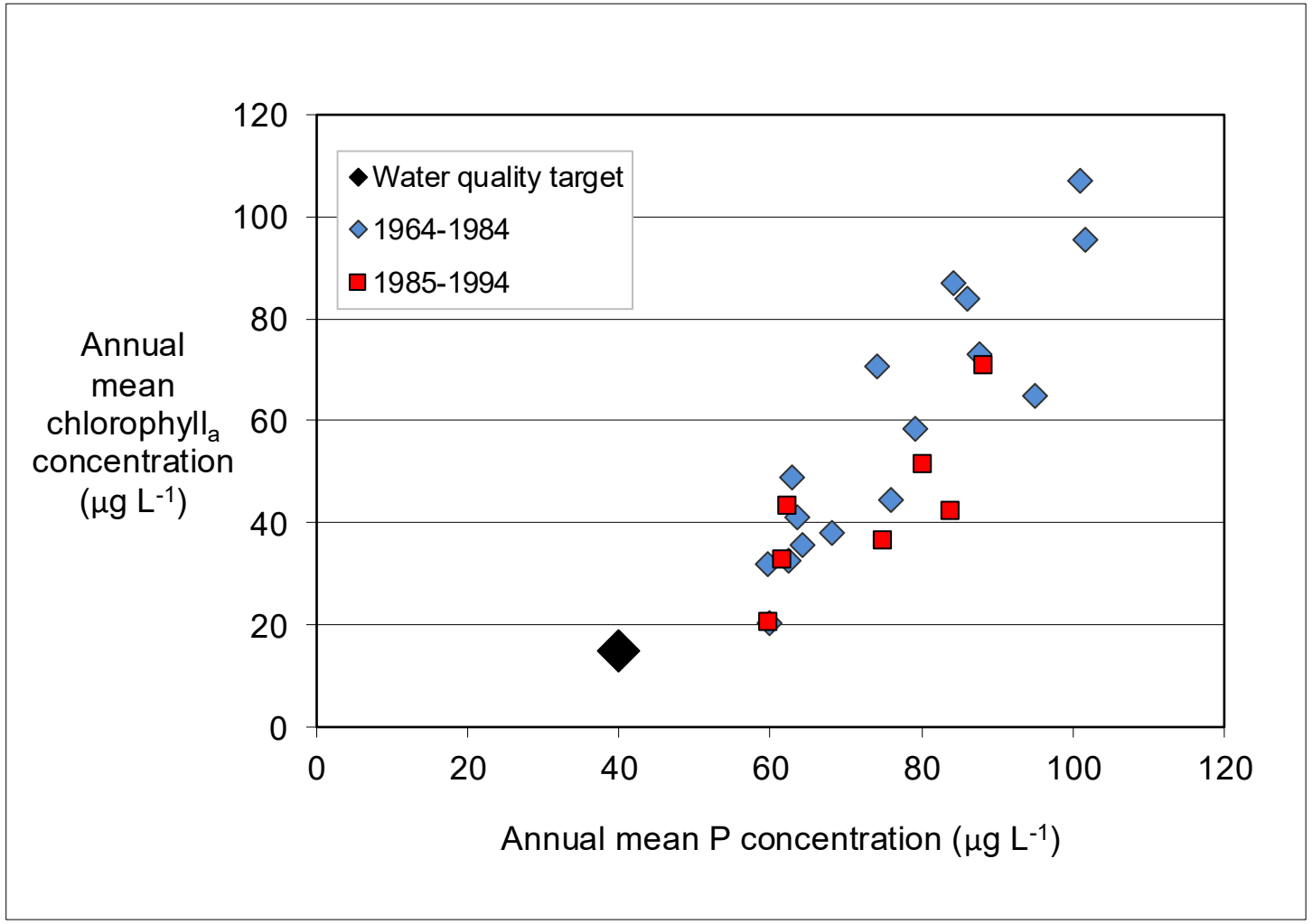
Impact on water quality



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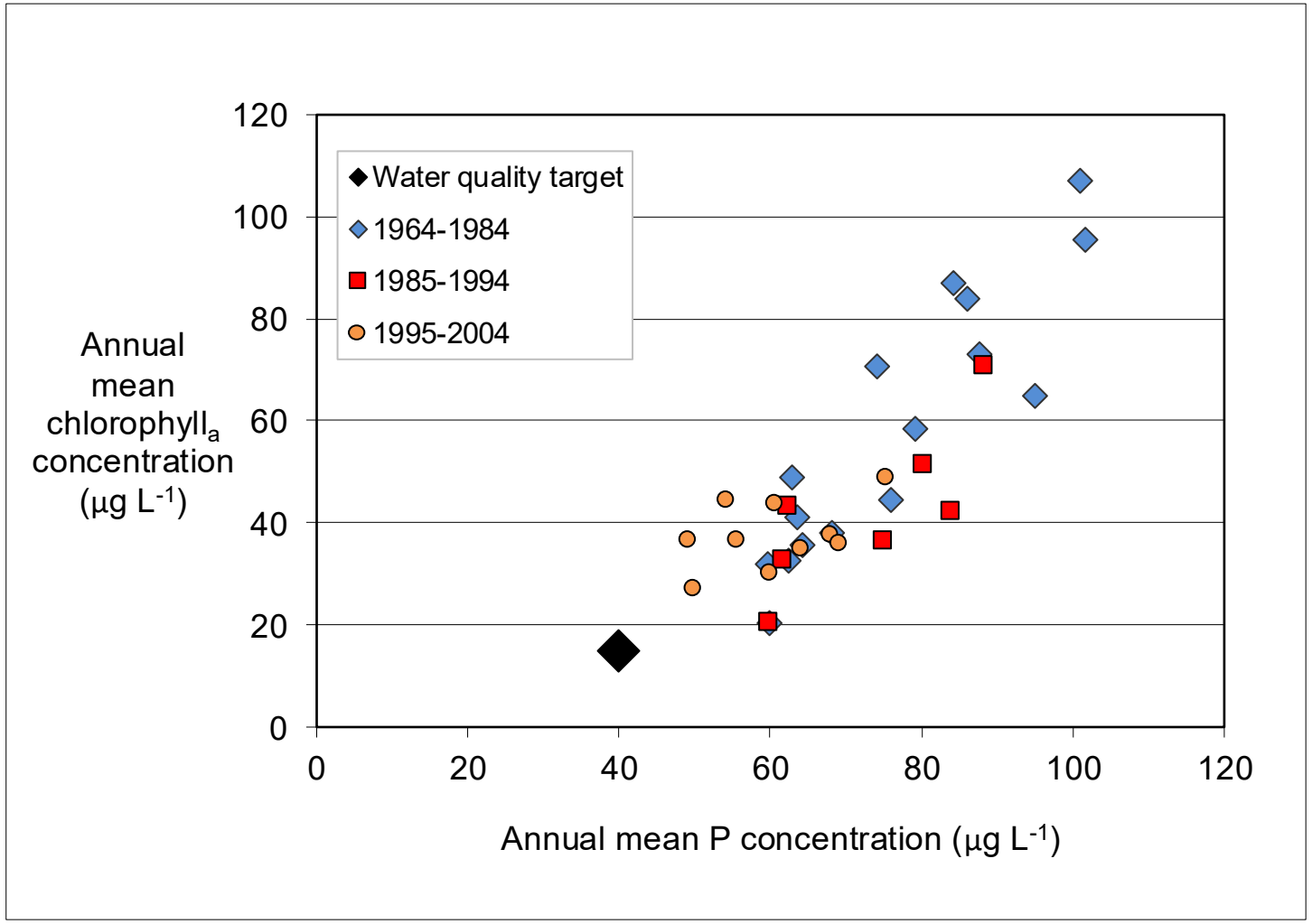
Impact on water quality



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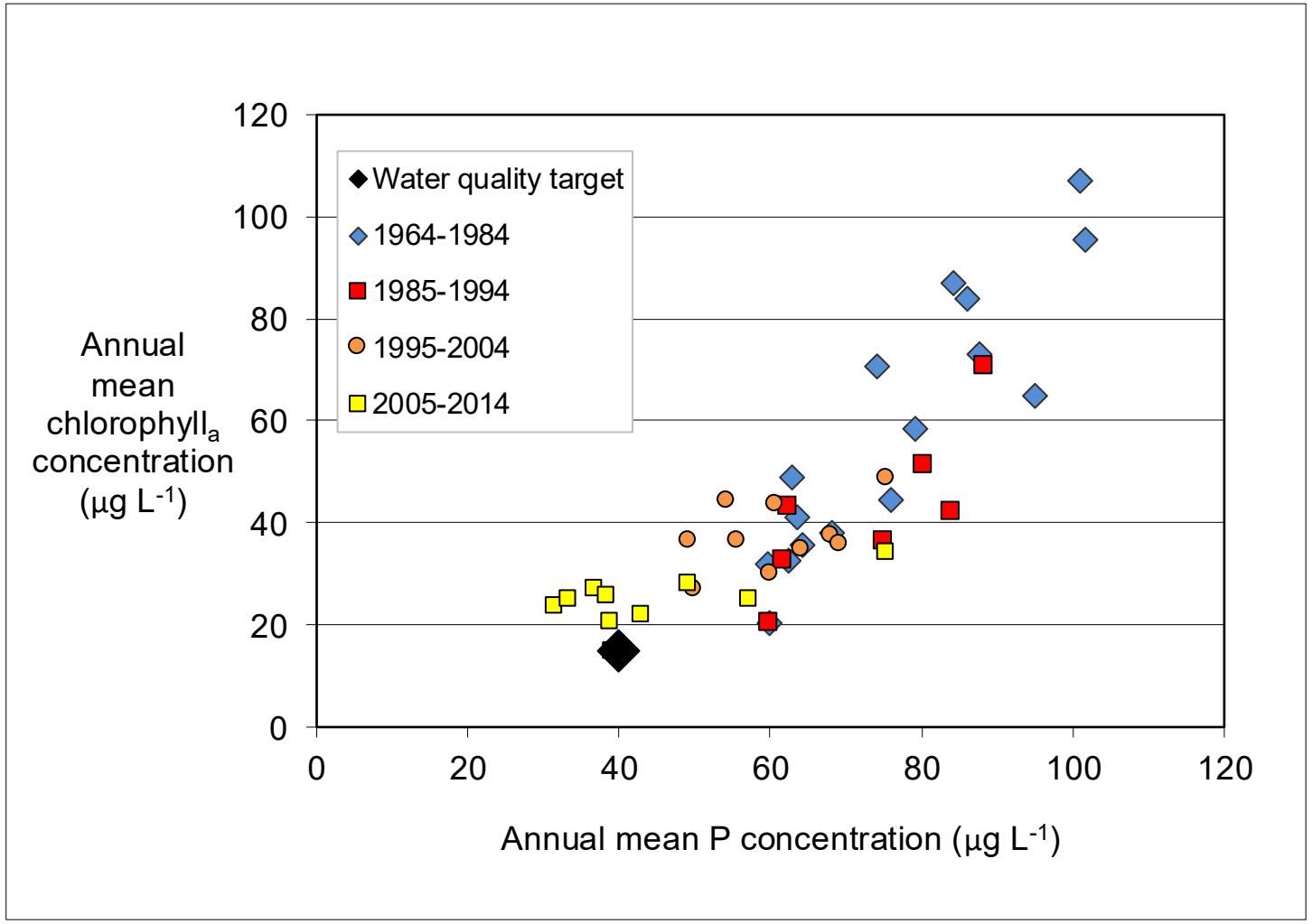
Impact on water quality



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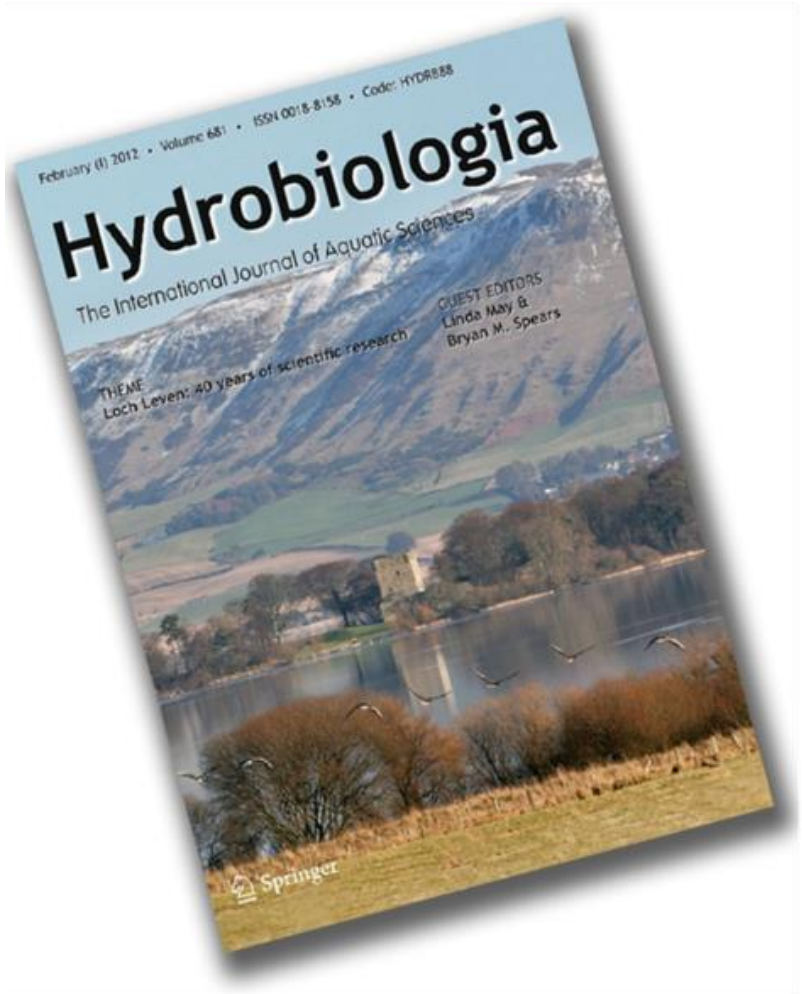
Better news by 2012!



THE HERALD WEDNESDAY 27.06.2012

Loch is booming after big blooming clean-up

REBECCA McQUILLAN

LOCH Leven in Perthshire was once known for the algal blooms that blighted it due to pollution.

It got so badly choked with slimy algae one weekend in June, 1992, that the event became known as Scum Saturday, causing a major alert 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 diversity and abundance of aquatic plant life.

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

SNH reports that pochard diving ducks, which eat aquatic plants and are in decline Scotland-wide, have increased in number on Loch Leven – from 1000 wintering birds in 1990 to 2400 in 2007. The increase is thought to be down to the proliferation of underwater plants.

Loch Leven trout fishery, which went into decline in the 1990s due to the pollution, is also improving. Last September, Michael Mackenzie of East Whitburn landed the largest brown trout to be caught in Loch Leven in a century, weighing 9lb 6oz.

Jamie Montgomery, of Kinross Estate Company, whose family owns the loch, said the fishery was "effectively dying" in 1990, with boats sold off. Since then, however, the clean-up has been "remarkably successful". He said: "If you talk to anglers here they'll say it's better conditions than they've had for ages."

Dr Linda May, deputy director of the water programme at the NERC Centre for Ecology and Hydrology, in Edinburgh, which compiled the report for SNH, has monitored the water quality at the loch for 36 years.

She said: "In 1976, we had lots of nasty blooms and the water wasn't very clean, but it's absolutely beautiful now.

"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 control the amount of phosphorous going in. It hasn't met the EU water quality target yet, though it's on its way towards it."

In the 1980s, phosphorous pollution from industry, agriculture and sewage was entering the loch in large quantities. As a plant nutrient, it caused blue-green algae to bloom on the surface of the water, blocking light to underwater plants, and water clarity was reduced to a depth of one metre.

It deterred visitors, as algal toxins can cause stomach upsets, eye infections and rashes. In June 1992, during calm weather, a large area of the loch's surface was covered with blue-green algae. The situation was exacerbated when it started to rot, becoming yellow and smelly.

Scum Saturday and its aftermath caused about £1 million of lost revenue to the community due to a fall in the number of people visiting the area for fishing and watersports.

Since then, efforts have been made to reduce phosphorous levels and the water clarity can now reach 4.7m in spring.

Measures included installing phosphorus scrubbing facilities at the local Scottish Water waste water treatment works, promoting better agricultural practices and strict controls on private waste water treatment systems.

Denise Reed, SNH Tayside & Grampians operations manager, said: "This is terrific news ... but we can't be complacent; we have to keep up our efforts to make sure the loch's water remains clean and healthy."

Dr May added Loch Leven now had eight tonnes of phosphorous entering it annually, down from 20 tonnes in the 1990s. Such a loch should have five or six tonnes going in to it from natural weathering of rocks and soil.

TESTS: Ecologist Dr Linda May and businessman Jamie Montgomery take samples from Loch Leven that show the improved water quality; talking over the algae problem back in 1992; Michael Mackenzie with the largest brown trout to be caught in the loch in 100 years. Picture: Gordon Terris

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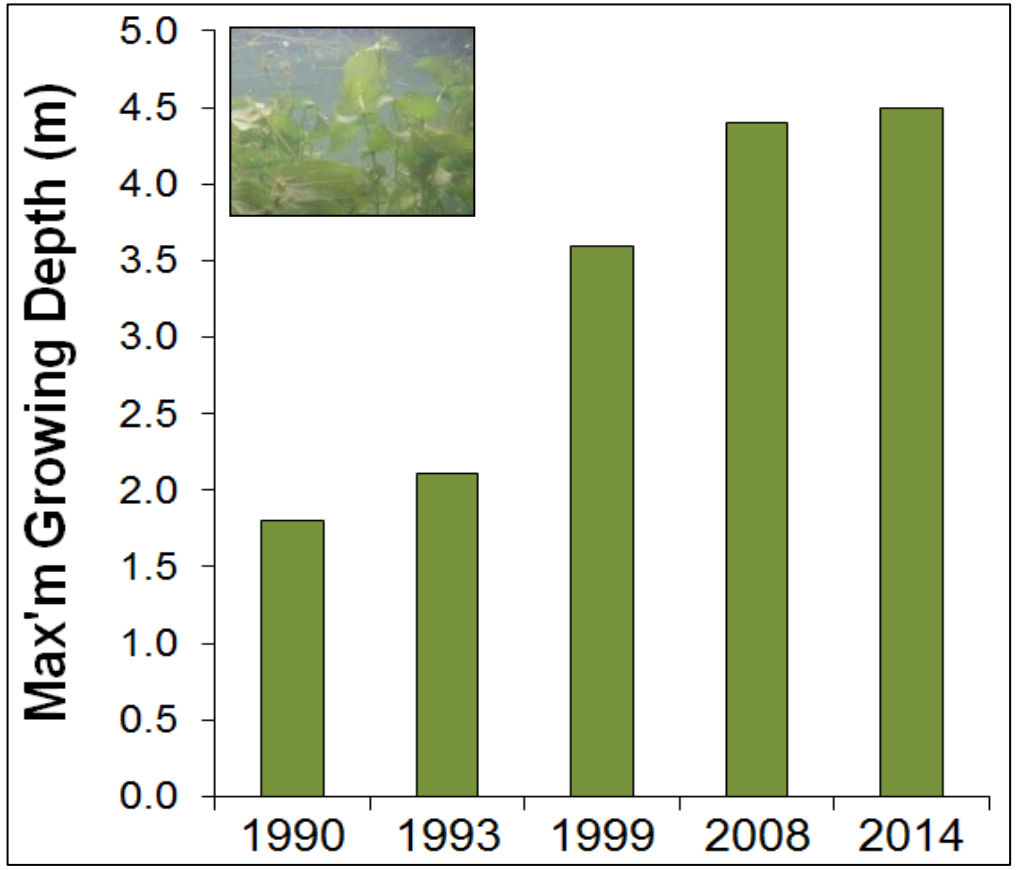
Effect on aquatic plants



Potamageton praelongus
re-appeared after 100 years

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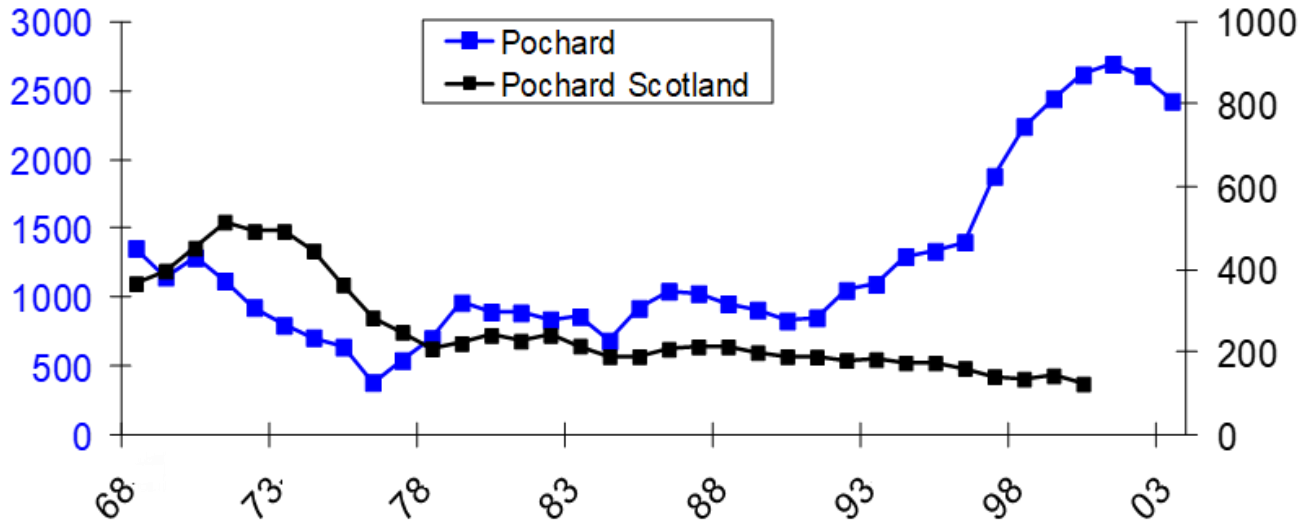
University of Glasgow

Effect on aquatic birds



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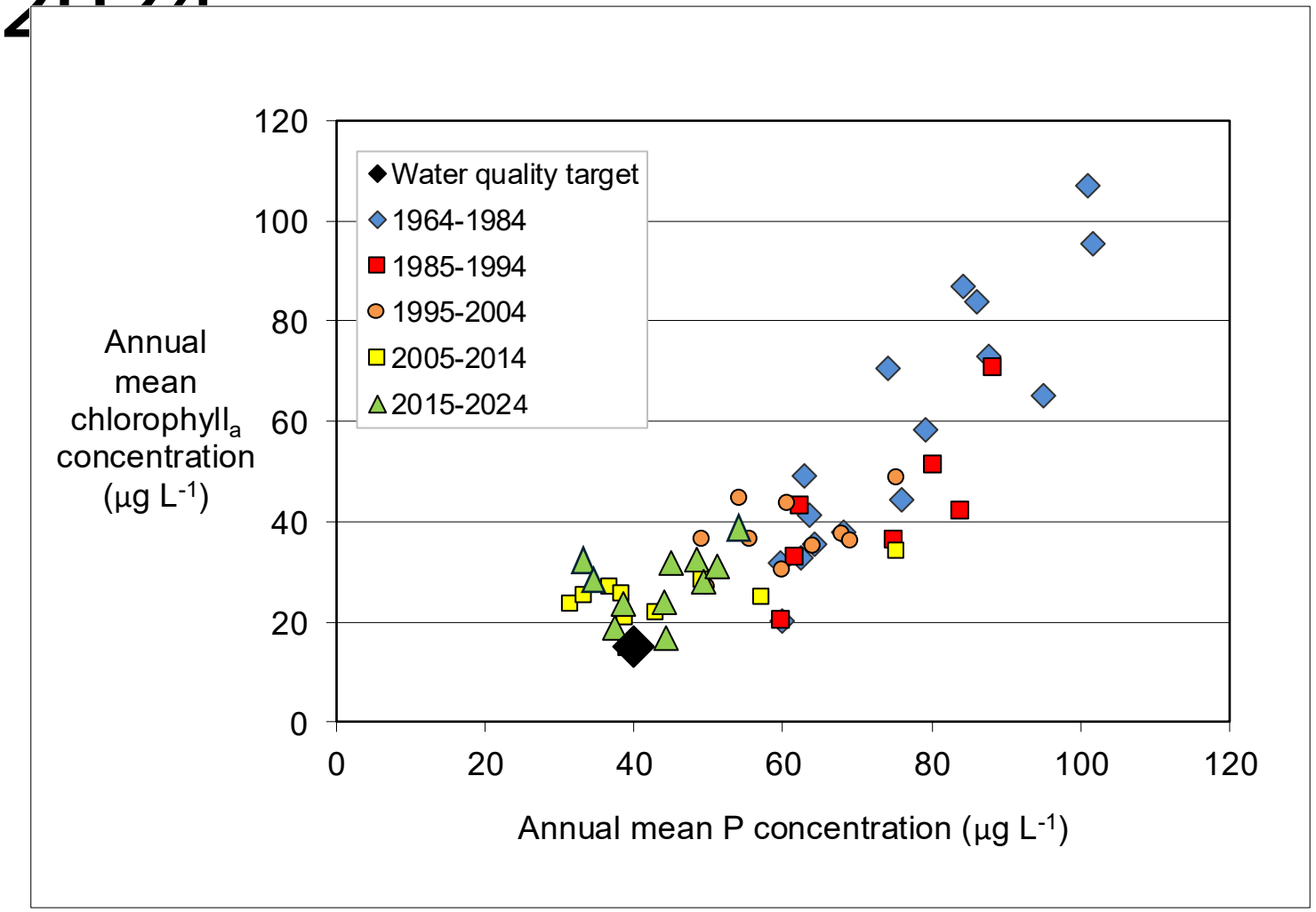
NatureScot
Scotland's Nature Agency
Buidheann Nàdair na h-Alba

1964 - 2024



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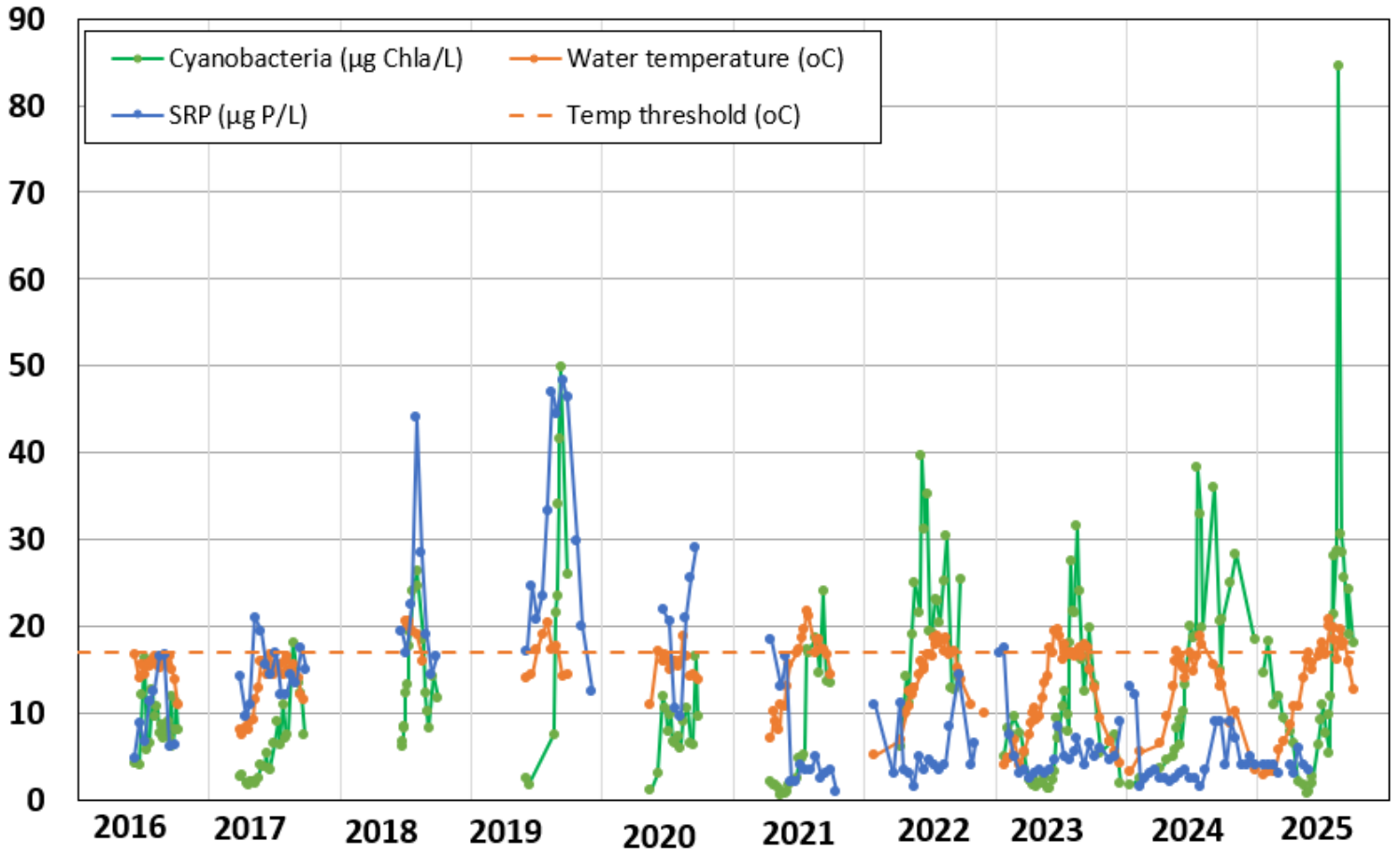
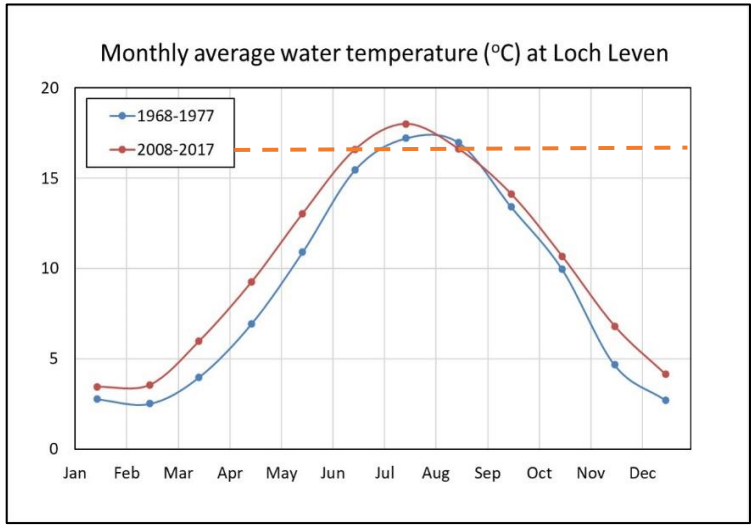
The return of cyanobacterial blooms (≥ 2018)





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Loch Leven Fisheries

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Scotland's Nature Agency
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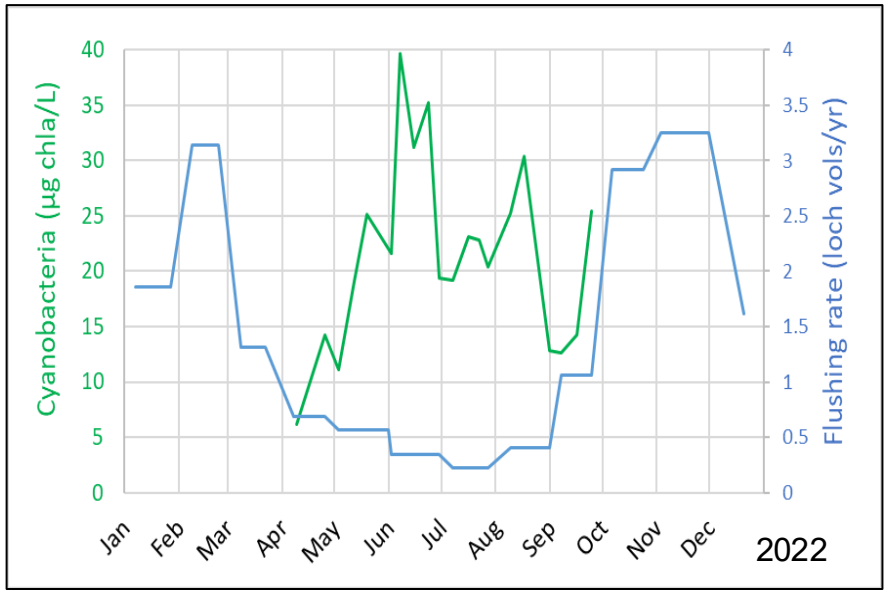
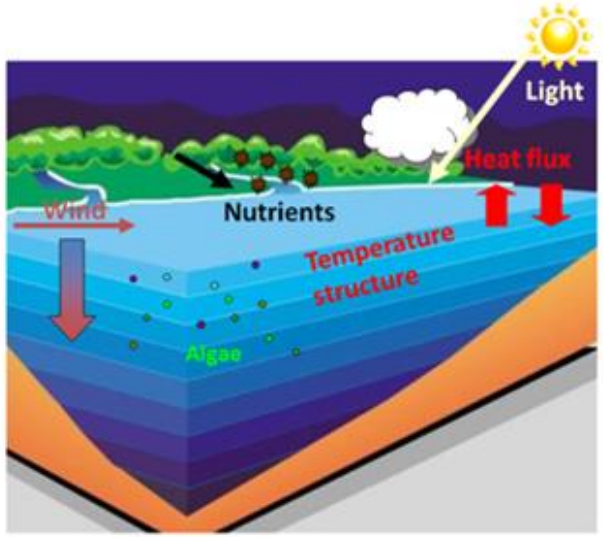
SEPA
Scottish Environment Protection Agency

Perth & Kinross Council

Effect of flushing rate on cyanobacterial blooms





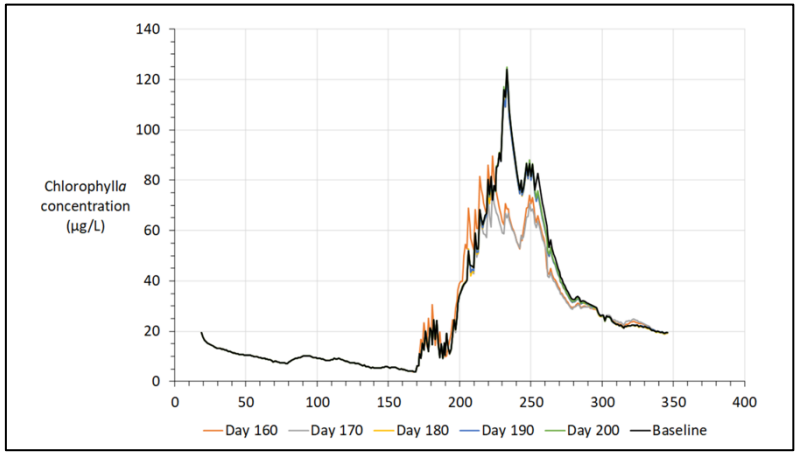
PROTECH: Predicts lake responses to change

Flushing scenarios tested

Outflow volume	Start dates	Duration (days)
x1.05	Day numbers 160, 170, 180, 190, 200	10
		20
x1.1		10
		20
x1.15		10
		20

Magnitude and direction of change of maximum chlorophylla concentrations under different flushing scenarios

		Flushing scenario					
		x1.05 & 10 days	x1.05 & 20 days	x1.1 & 10 days	x1.1 & 20 days	x1.15 & 10 days	x1.15 & 20 days
Start date	Baseline	0%	0%	0%	0%	0%	0%
	Day 160	-28%	-31%	+9%	+1%	-24%	+17%
	Day 170	-37%	-36%	-26%	-34%	-28%	+4%
	Day 180	-2%	-37%	-39%	-36%	-36%	-2%
	Day 190	-2%	-2%	-37%	-39%	-39%	-37%
	Day 200	+1%	-2%	-3%	-1%	-1%	0%



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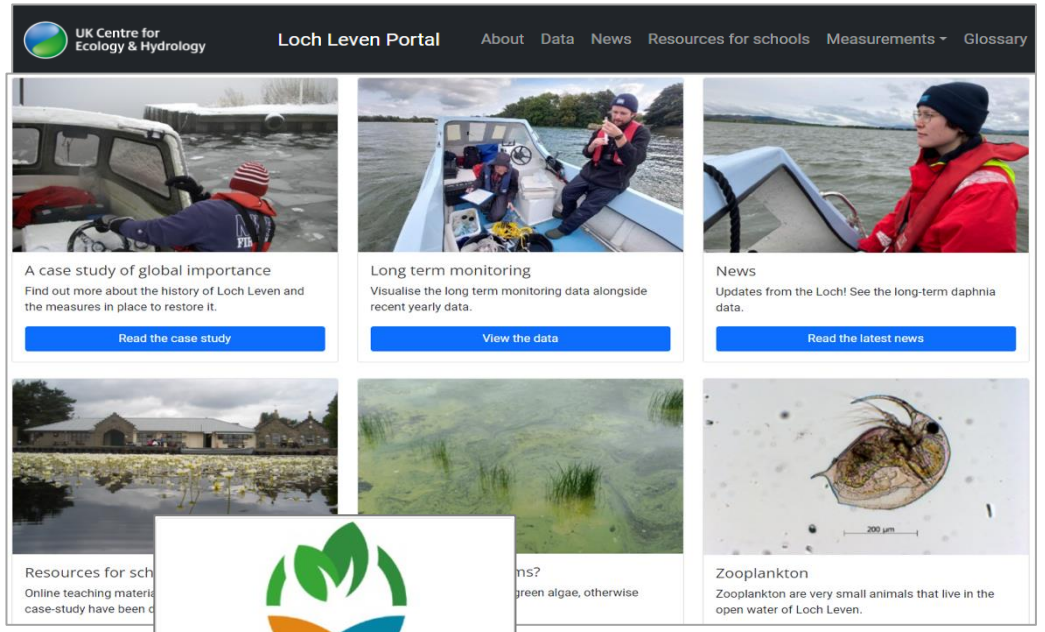
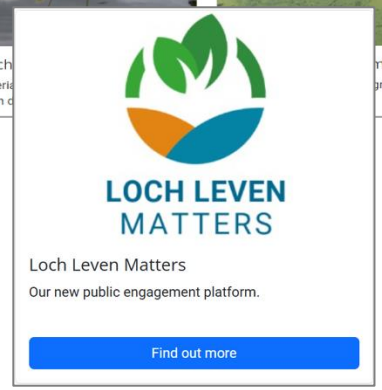
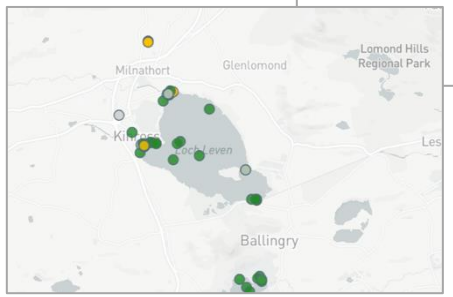
The James Hutton Institute

Scottish Government
Riaghaltas na h-Alba
gov.scot

Community engagement







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For Nature, Climate and People

UK Research and Innovation

Lessons learned

Needs a coordinated, inclusive, evidence based approach to management (not biased and alarmist headlines).

Needs a better understanding of how climate change is making lakes more sensitive to nutrient inputs and how this affects water quality targets.

Needs lessons learned at Loch Leven, and elsewhere, to be shared with other lake restoration projects around the world.

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Stakeholders

And many more …


Thank you for listening
Any questions?