CREW CENTRE OF EXPERTISE FOR WATERS

Climate change mitigation measures for Scottish standing waters

Policy Brief

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Key Recommendations

- **Revising River Basin Management Planning, Scotland's National Adaptation Planning, and current nutrient status criteria for Scottish standing waters as a climate change mitigation/adaptation strategy.**
- **Establishing key indicators of climate-related risks to inform adaptive water policy and management practices.**
- **Introducing stricter controls on nutrient losses to water from agricultural, industrial and sewage related sources to reduce the likelihood of potentially harmful algal blooms.**
- **Leveraging the future agriculture bill in Scotland to encourage sustainable and regenerative agricultural practices, such as those promoted under the Net Zero targets.**
- **Coupling any mitigation practices with the adoption of lower greenhouse gas emissions pathways to maximise effectiveness into the future.**

Background

Scottish standing waters are already warming at an alarming rate and are projected to continue warming into the future, as shown by May *et al.* (2022a, b). These changes are likely to cause more frequent and/or more intense algal blooms, increasing the risk **of harmful toxins being released into the water by cyanobacteria**, also known as blue-green algae. Harmful algal blooms can have detrimental impacts on Natural Capital, such as:

- **Reducing the amenity value of locally important still waters** (e.g. for recreational use, water supply and wellbeing) and **affecting property values**, especially when cyanobacterial concentrations exceed World Health Organisation thresholds for safe use of water.
- **Increasing greenhouse gas emissions from affected waterbodies.**
- **Increasing the risk of local extinctions** caused by habitat degradation that exceeds the level of tolerance of species of high conservation concern.

The future quality of Scottish standing waters is very dependent upon the climate change scenario and socio-economic pathway that we follow. This policy brief presents information on the main **drivers of water quality problems in Scottish standing waters**, how these will be affected by climate change and how these impacts can be reduced by introducing fit for purpose mitigation strategies, within a policy development context. As supported by the recent Climate Change Committee (2022). Is Scotland climate ready? – 2022 report to Scottish Parliament, **adaptations to current water policy and existing monitoring networks** will need to be included in Scotland's strategic and coordinated response (e.g. the SCCAP2 programme) to reducing climate change impacts on these waterbodies.

Key Findings

Drivers and consequences of water quality problems in Scottish lochs:

- The main causes of poor water quality, especially algal blooms, in Scottish standing waters are high phosphorus concentrations, and periods of low rainfall and warm weather.
- The risk of harmful algal blooms is projected to increase under climate change, with consequent detrimental effects on water use, water quality, water supply, amenity and habitat value, biodiversity, and health and wellbeing.
- The cost of algal blooms to the Scottish economy, based on limited data, was estimated to be at least £16.5 million per year, excluding the medical and veterinary costs incurred when they affect the health of people, pets and livestock; however, a detailed site-specific study at Loch Leven (£2 million per year) suggests that this figure is likely to be much higher.

- Runoff from land, especially farmland, is the main source of phosphorus entering Scottish standing waters and is likely to increase due to climate change.
- Less than one percent of the 6,836 standing waters included in this study receive effluent from waste water treatment works. However, there are some lochs where this is known to be an issue and tackling it builds resilience to climate change related impacts.
- The equivalent cost to treat water to reduce phosphorus runoff before it enters our lochs is estimated to be about £56.4 million per year.

Measures to mitigate climate change impacts to Scottish lochs:

- Phosphorus laden runoff into standing waters can be reduced by adopting more sustainable land use practices, such as **using soil testing to optimise fertiliser applications to agronomic requirements**. This could almost halve phosphorus losses from land to water, whereas increasing the extent of buffer strips may only reduce these losses by about 1%.
- Adopting **sustainable land use practices and achieving low greenhouse gas emissions** would result in a *c.* **20% reduction in phosphorus runoff** by 2080 compared to present-day conditions; this may improve water quality in *c.* 85% of Scotland's standing waters.
- In contrast, adopting **high intensity farming practices and not achieving low greenhouse gas emissions will more than double phosphorus runoff,** resulting in only about a third of our standing waters achieving high quality water by 2080.
- In terms of compliance with Water Framework Directive (WFD) water quality targets, **sustainable land use practices and low greenhouse gas emissions would result in about 90% of Scottish lochs achieving Good Status or higher by 2080,** whereas under a future characterised by **high intensity farming practices and failure to achieve low greenhouse gas emissions, less than half of Scottish lochs would achieve this status** (Figure 1).
- There is **limited evidence on the effectiveness of implementing in-lake measures** to reduce climate change impacts; further research is needed.

Implications for Policy

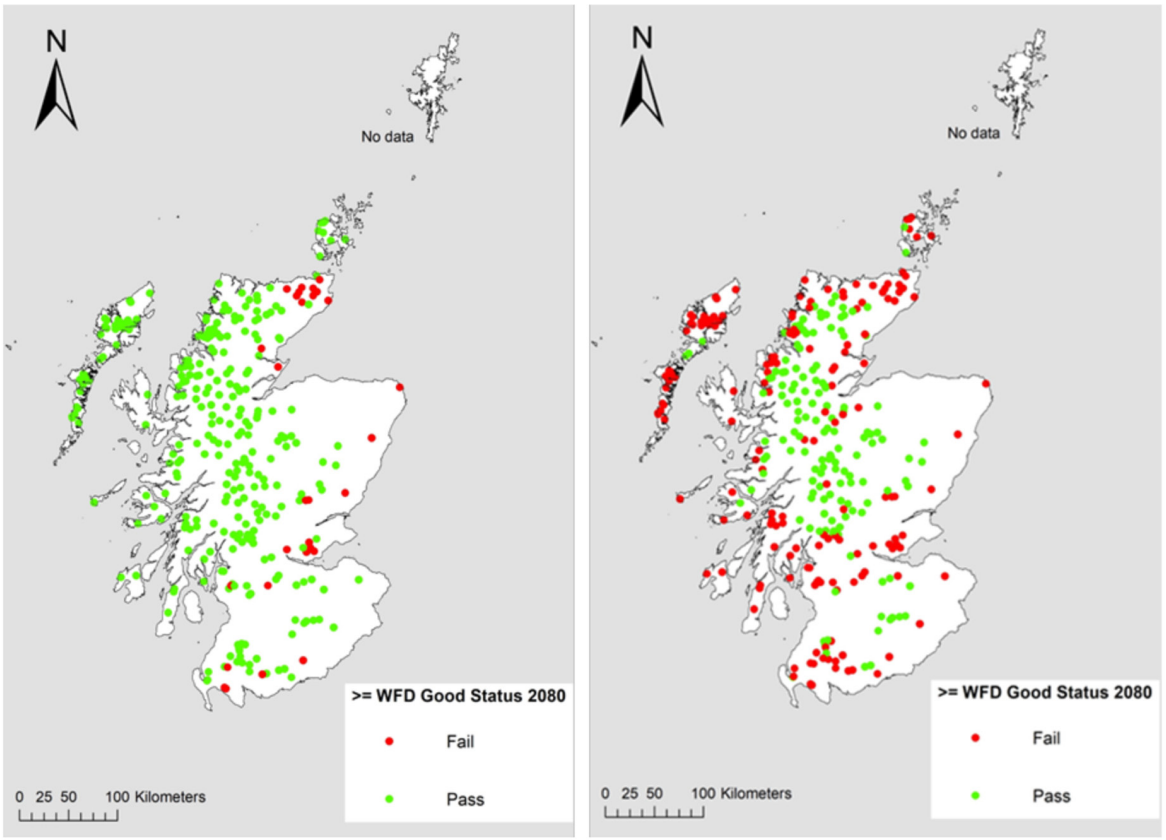

Figure 1. Scottish lochs projected to pass or fail Water Framework Directive (WFD) targets for Good Status or higher by 2080 under a low greenhouse gas emissions and sustainable land use future (left panel) compared to a future characterised by high greenhouse gas emissions and more intensive agriculture (right panel).

Our findings have relevance to, but not exclusively: River Basin Management Plan for Scotland 2021-2027, Scotland's Third Land Use Strategy 2021-2026. Getting the best from our land. Scottish Government (2021)). Considering the key findings detailed above, our main recommendations for policy include:

- **Improving national-scale data collection and monitoring** to improve estimates of the financial impacts of algal blooms on Scotland, including estimates of water treatment and phosphorus removal costs.
- **Establishing key indicators of climate-related risks** to inform adaptive water policy and management practices. For example: monitoring water temperatures at an accuracy of about 0.1 degrees Centigrade and measuring nutrient inputs from catchments. This would provide early warning of an increasing risk of algal blooms.
- **Accelerating the trialling of in-lake measures**, perhaps through Scotland's Hydro Nation Research and Innovation Programme, to identify measures that are suitable for Scottish standing waters.
- **Introducing stricter controls on nutrient losses to water from agricultural, industrial and sewage related sources** to reduce the likelihood of potentially harmful algal blooms. To be effective, future licensing criteria will need to take climate change into account.
- **Setting up in-lake habitat improvement or species translocation programmes** where future habitat degradation is projected to exceed the tolerances of species of high conservation concern.
- **Revising River Basin Management Planning** to reflect that sensitivity to changes in climate and land use varies regionally and by waterbody type.
- **Revising Scotland's National Adaptation Planning** to include a roadmap for adapting to, or mitigating, the effects of climate change on standing waters.
- **Revising current nutrient status criteria** for Scottish standing waters as a climate change mitigation/adaptation strategy. In relation to meeting EU Water Framework Directive (WFD) (EU Water Framework Directive (2000)) targets for Scottish standing waters, it may be necessary to recast the WFD given that baseline conditions that underpin the WFD concept will have changed under current climate change.
- **Leveraging the future agriculture bill in Scotland to encourage sustainable and regenerative agricultural practices,** such as those promoted under the Net Zero targets, including encouraging improved nutrient use efficiency through regular soil testing and optimising fertiliser application rates. For maximum effectiveness, these practices must be coupled with the adoption of **lower greenhouse gas emissions pathways** into the future.

References

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