Optimising Multi-Pollutant Phytoremediation Strategies to Sustainably Improve Water Quality

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1. Overview

Macrophytes (aquatic plants) have a demonstrable ability to sequester water borne pollutants. However, **most studies focus on single plant species targeting single pollutants ignoring the benefits that a plant community could offer for remediating multi-diffuse pollutant impacted waters.**

Macrophytes can also be harvested to recycle or dispose of pollutants. **There is a need to integrate the remediation stage with sustainable pathways for re-use of plant biomass containing pollutants**. Therefore, a clear set of context-specific strategies requires development.

The overarching aim of this project is to optimise a series of strategies that can improve water quality by exploiting the ability of aquatic plants to assimilate waterborne pollutants. This will be achieved by:

- Identifying aquatic plant combinations that provide maximum sequestration potential for a range of diffuse pollutants
- Developing novel ecological engineering solutions
- Carrying out field-scale experiments to determine realistic extraction efficiency rates, and model potential for scaling up
- Calculating the economic practicality of scaling up phytoremediation strategies in Scotland in both monetary and non-monetary terms

2. Identifying aquatic plant combinations: experimental design

- Mesocosm experiments will assess the removal rates & bioaccumulation of pollutants including Nitrogen, Phosphorus and heavy metals using macrophytes with phytoremediation potential, grown both in monoculture & polyculture
- The role of microbial biofilms on removal will be assessed by including an inert (plastic) control

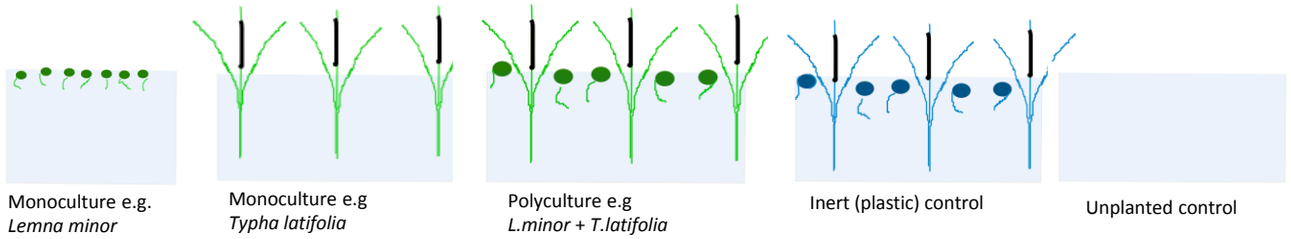


Fig.1: Example experimental design set-up for mesocosm experiments

Table 1: Imposed environmental conditions during experiments

Target water type	Eutrophic water, heavy metal pollution
Temperature regime	11-22°C
Humidity	78-80%
Light regime (day: night)	16h:8 h
Light intensity	200µmol/m²/s

3. Future project work

3.1 Test macrophyte combinations

A series of mesocosm studies combining different macrophytes will inform which vegetation communities to use during field trials (Fig.2).

Iris pseudacorus

Callitriche stagnalis

Spirodela polyrhiza

Figure 2: Examples of Emergent, submerged & floating macrophyte species that will be testing during initial mesocosm studies

3.2 Field scale studies

Deploy macrophyte communities in waters impacted by multi-diffuse pollutants including field ditches, aquacultural effluents & eutrophic lakes.

Fig.2: Eutrophic lake (example target water type for phytoremediation)

Fig.3: Floating Treatment Wetland

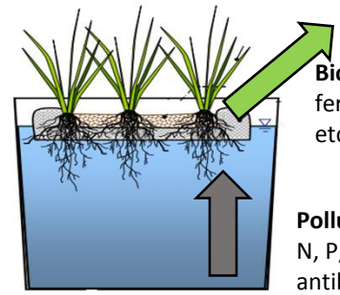
Novel ecological engineering solutions including floating treatment wetlands will also be employed to facilitate maximum pollutant removal and efficient harvesting.

3.3 Evaluate and scale-up whole phytoremediation process

Develop post-remediation biomass re-use streams (PBRSs) for appropriate recycling of harvested biomass.

Value ecosystem services provided by phytoremediation strategies to scale-up up the costs of & benefits of phytoremediation to catchment and national level.

Ecosystem services e.g. Carbon sequestration, pollination.



Biomass harvest, for fertiliser, feed, biofuel etc.

Pollutant uptake e.g. N, P, heavy metals, antibiotics.

Fig.4: Example phytoremediation concept