Multi-pollutant phytoremediation of eutrophic and metal contaminated water

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BES Winter Symposium 2018-Dec 2018

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Multi-diffuse pollutants -catchment sources and impacts

Agricultural run-off

Industrial legacy

Pollution events

Aquaculture

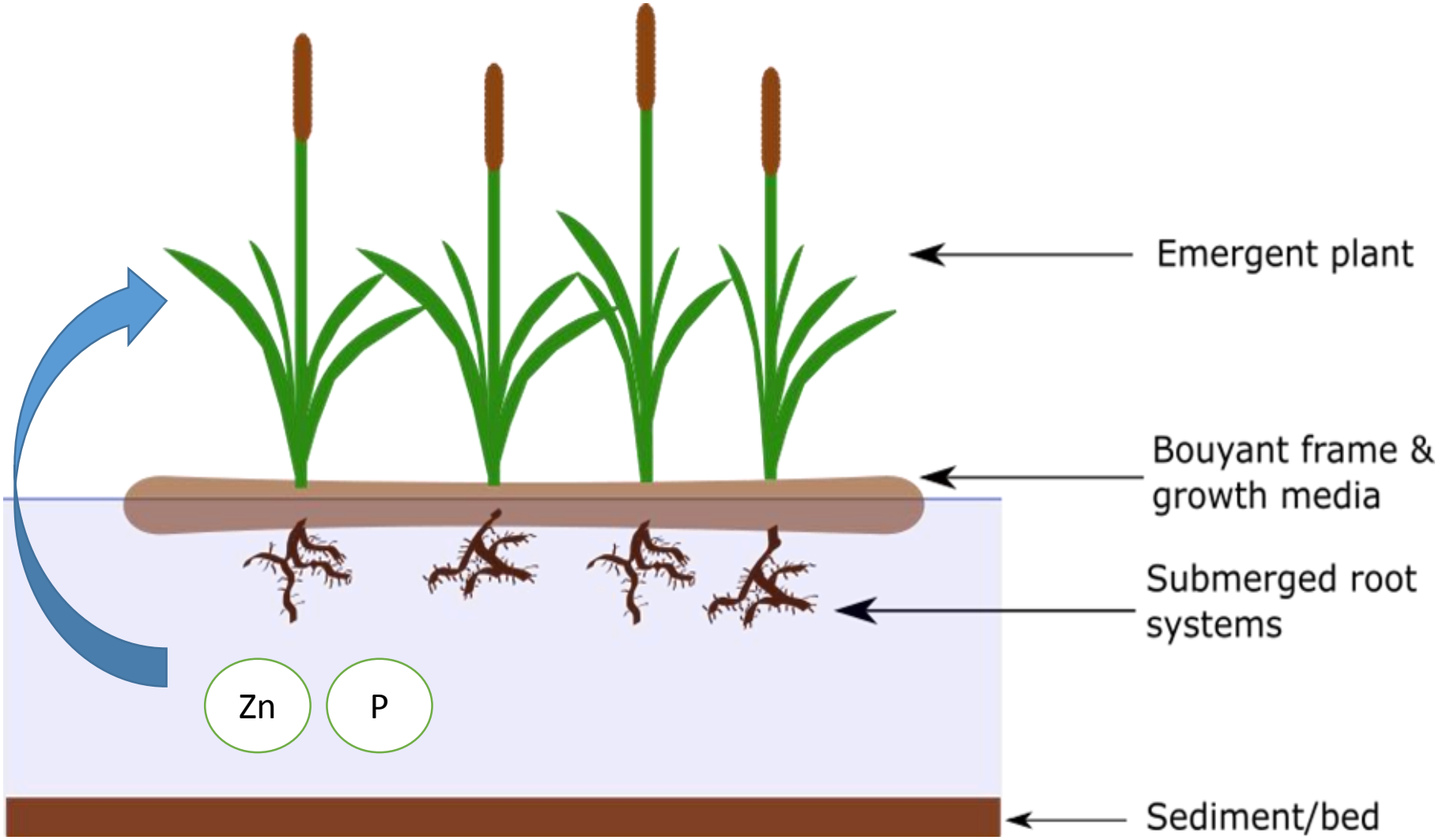
Eutrophication

Metal contamination

Organic contamination

Multi-diffuse pollutant impact

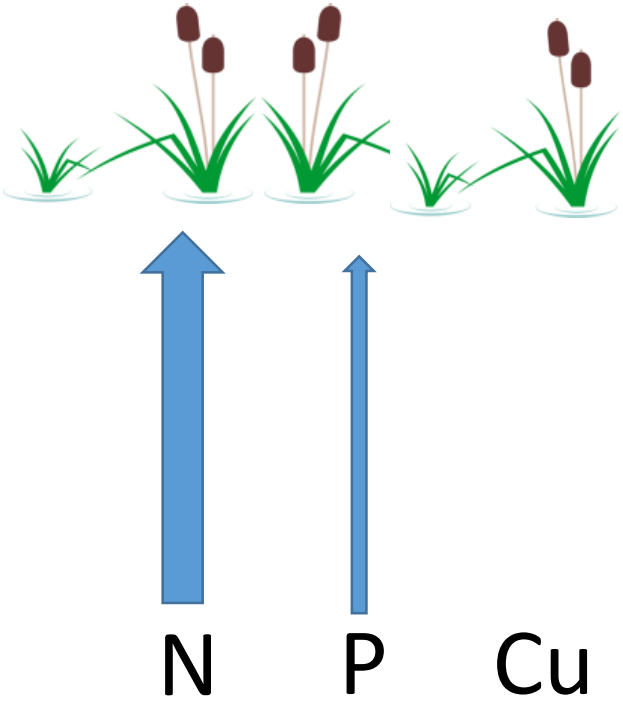
Phytoremediation & floating treatment wetlands (FTWs)



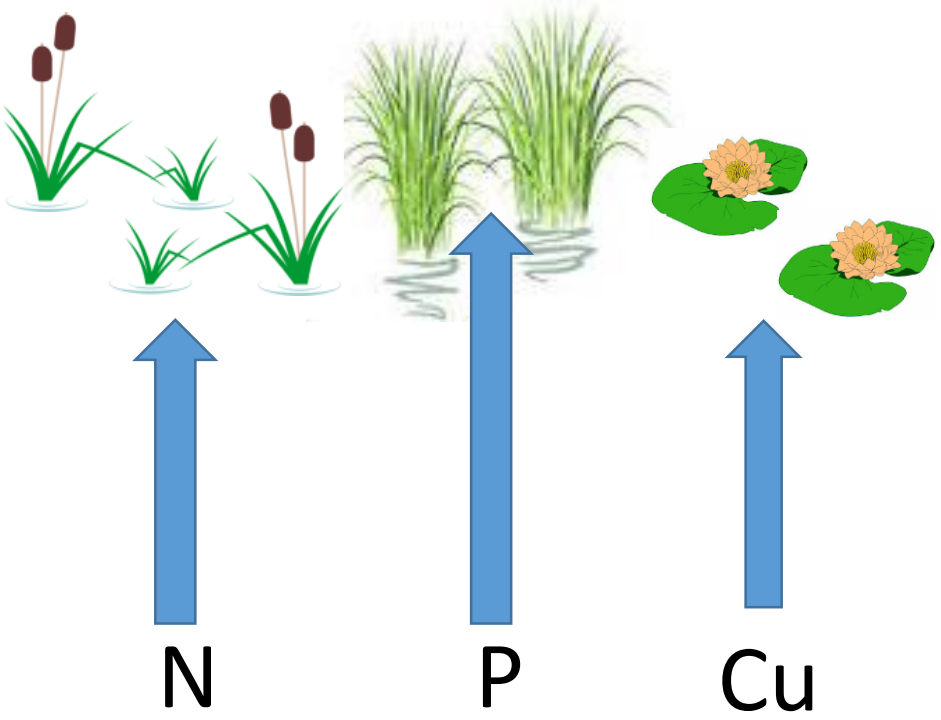
Example target freshwaters: Lakes, pond, Canals, streams (particularly 1st order)

Multi-pollutant phytoremediation

Monoculture



Community



Experiment rationale

- **Optimal combination(s) of macrophytes for FTWs**
- **Impact of intense plant competition on pollutant removal**

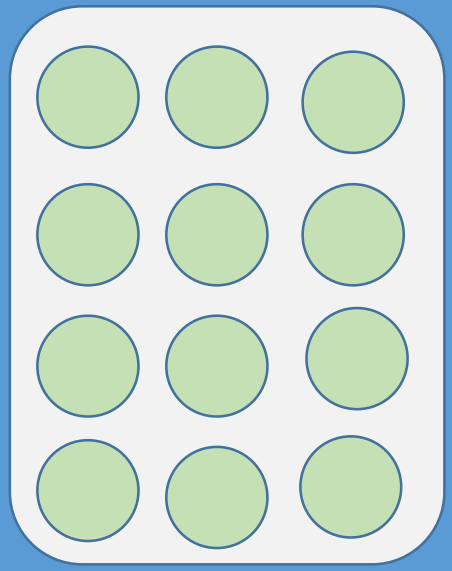
Glyceria maxima

Typha latifolia

Phragmites australis

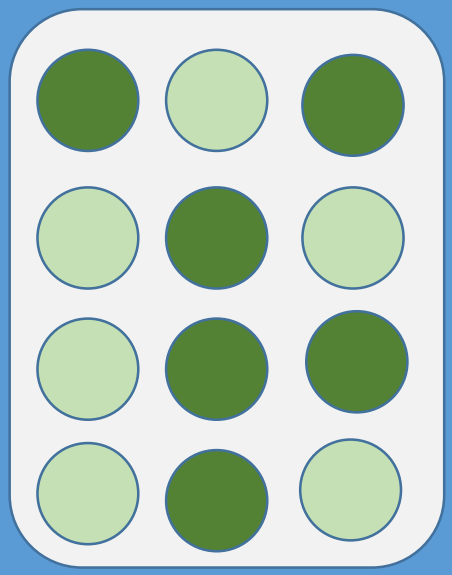
Experiment treatments & planting order

Monoculture



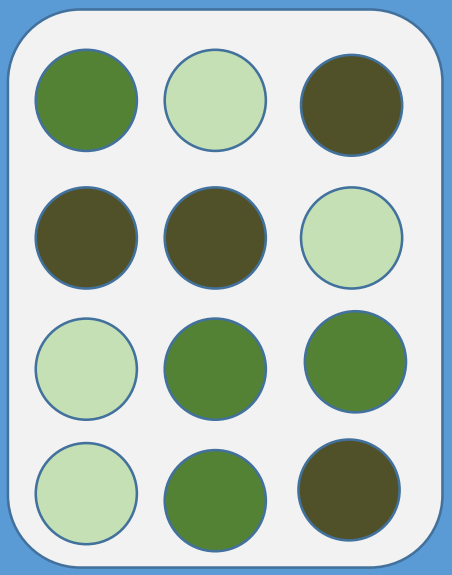
T. lat. (TL)
G. max (GM)
P. Aus (PA)

Bi-culture



T. lat. + G. max (TL+GM)
G. Max + P. aus (GM+PA)
T. lat + P. aus (TL+PA)

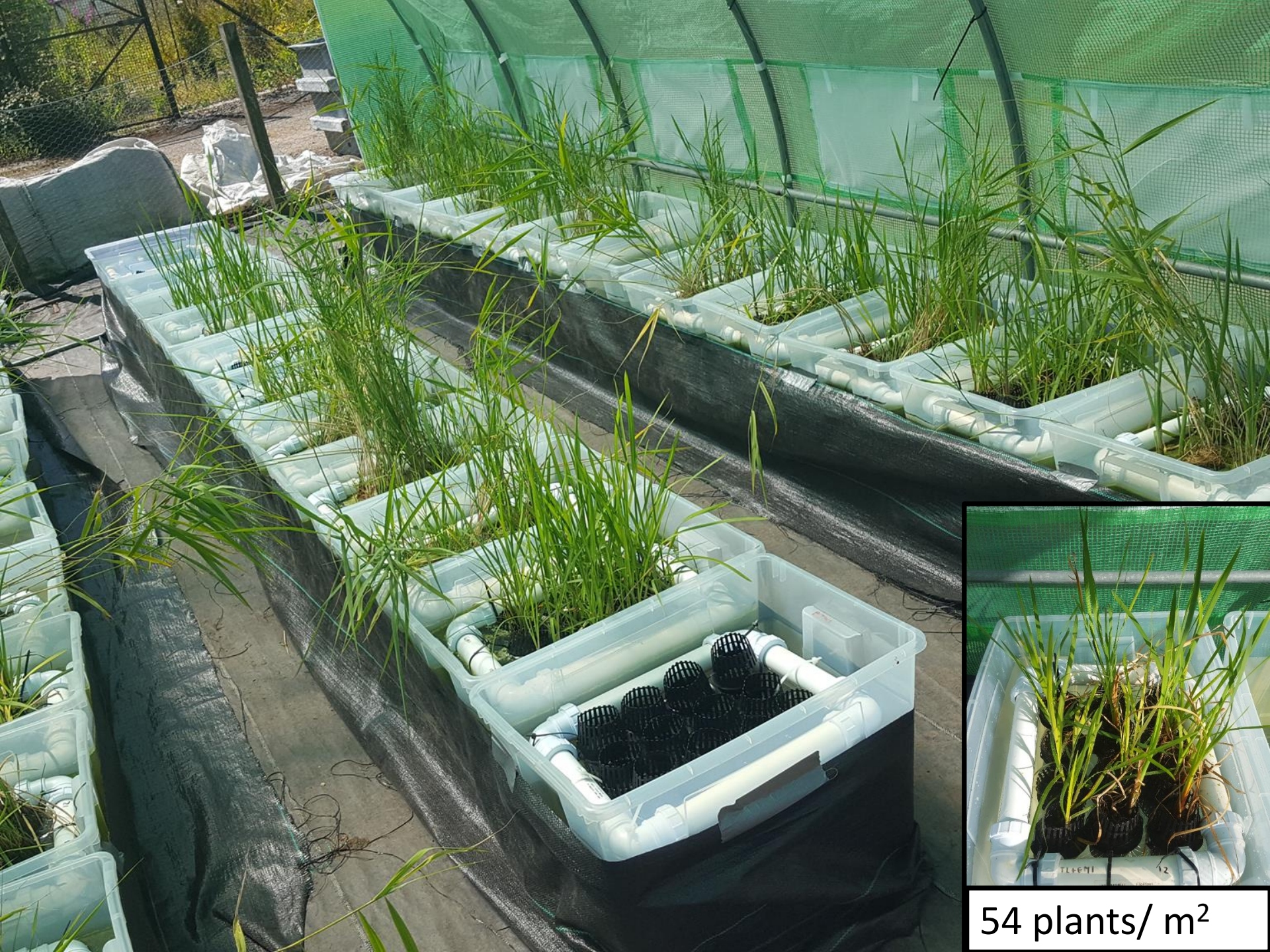
Polyculture



T. lat. + G. max +
P. aus (PC)

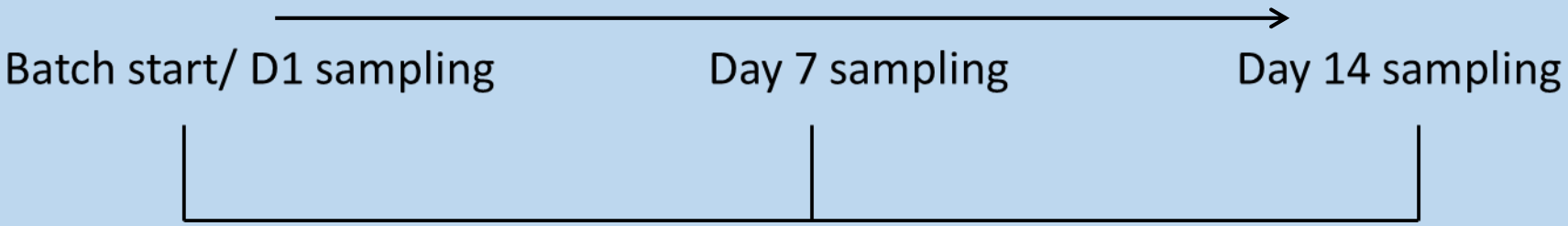
Negative Control: No FTW

Positive Controls: Unplanted FTW


54 plants/ m²

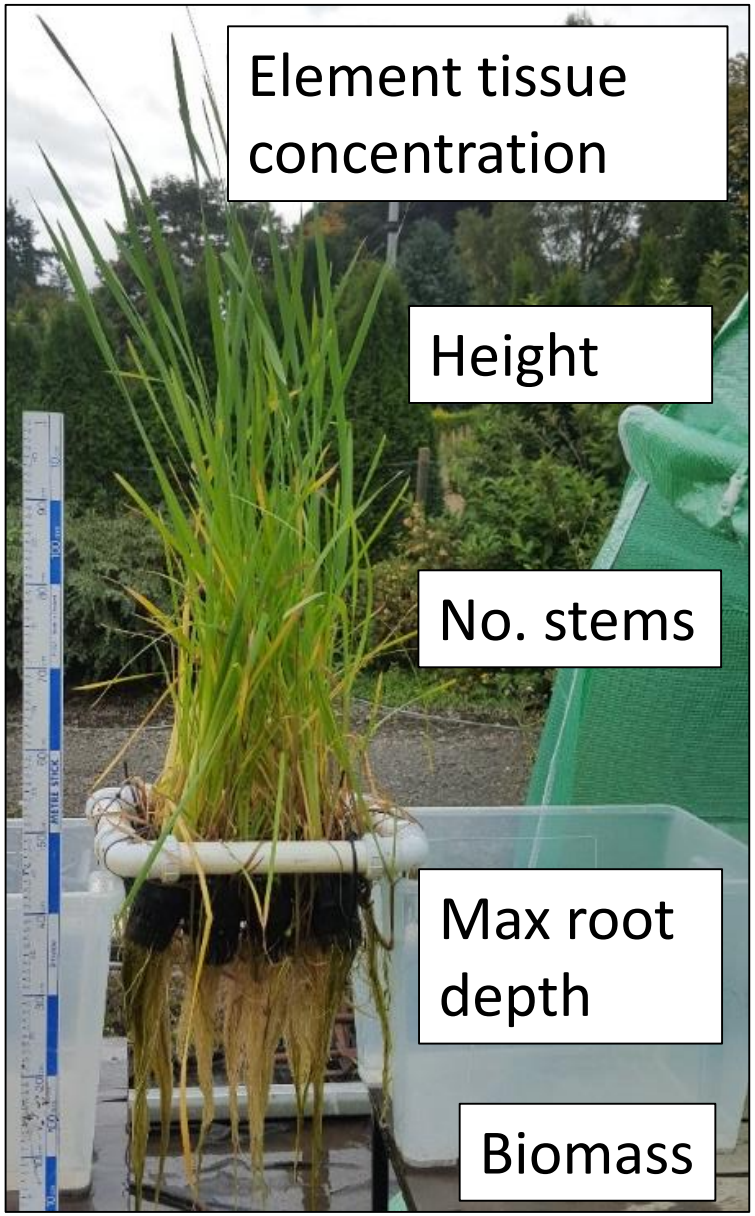
Experiment timeline & simulated polluted water

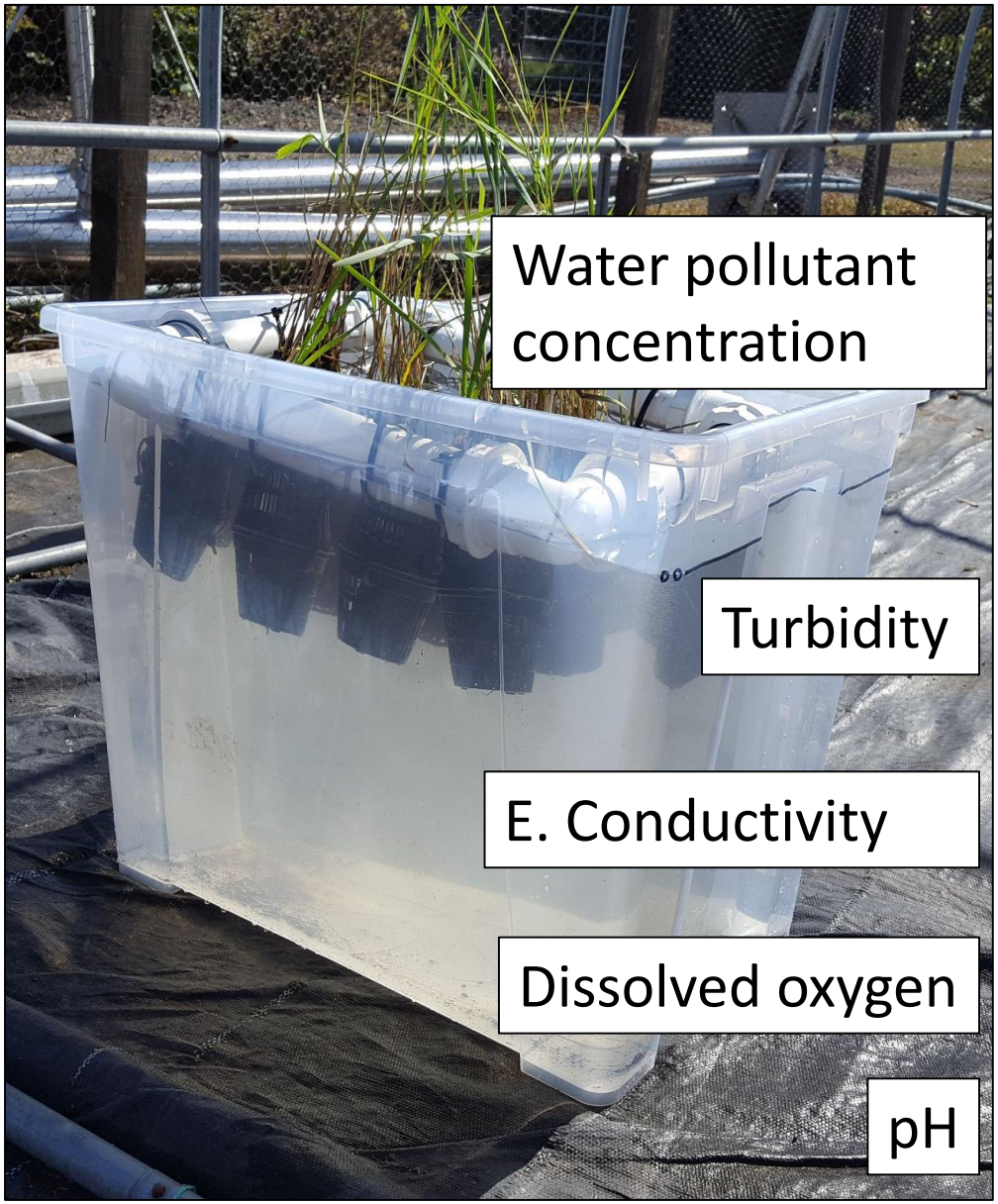
Duration: 2.5 months (June-September), 5 batches



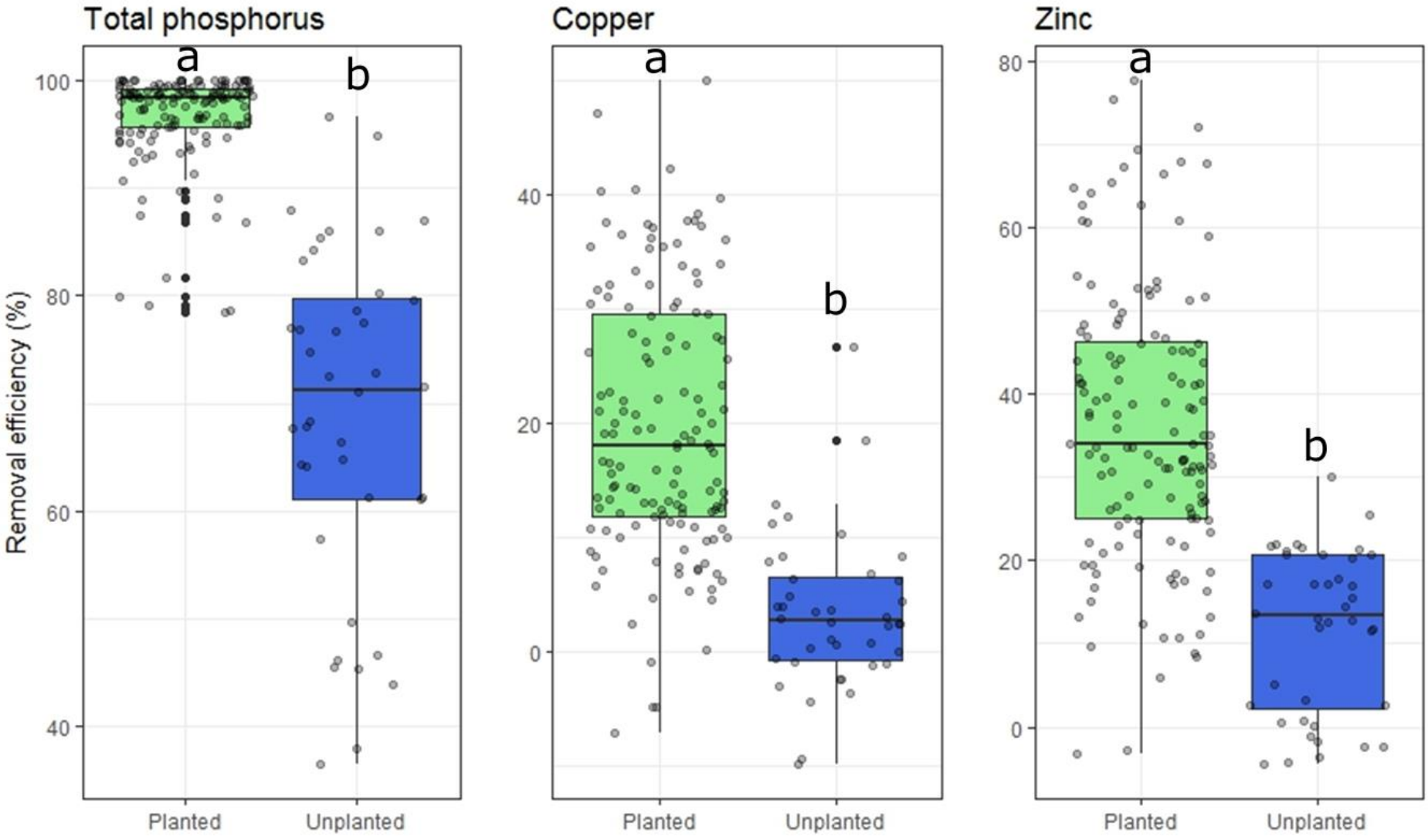
Element	Simulated concentrations (µg/l)
Total nitrogen	2,500
Total phosphorus	700
Copper	25
Zinc	120
Manganese	300
Iron	3,000
Chromium (IV)	50

Plant and water sampling



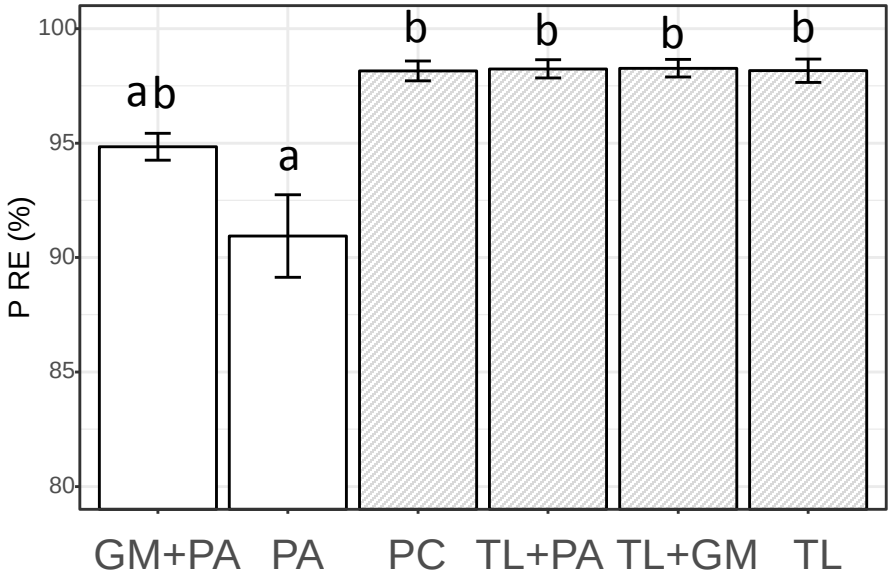


Do FTWs improve water quality?

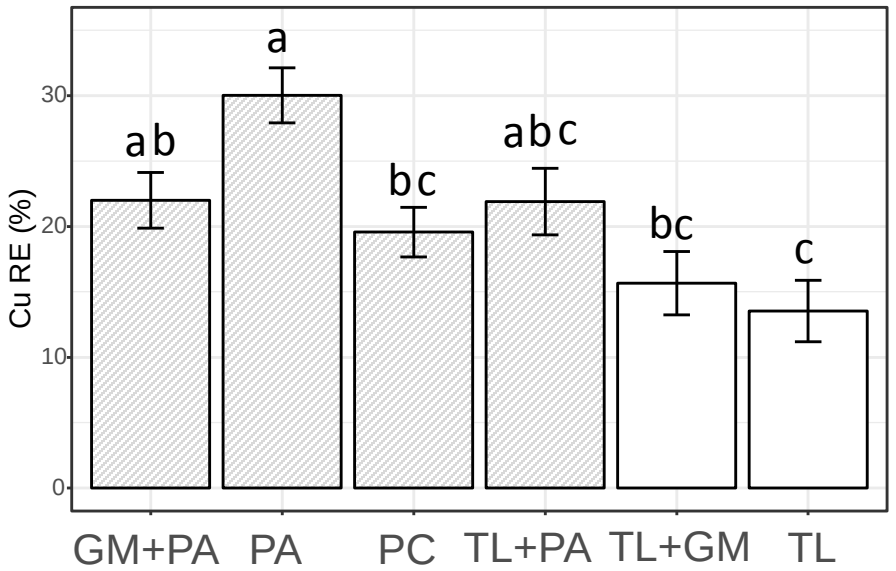


Can any plant combinations multi-target?

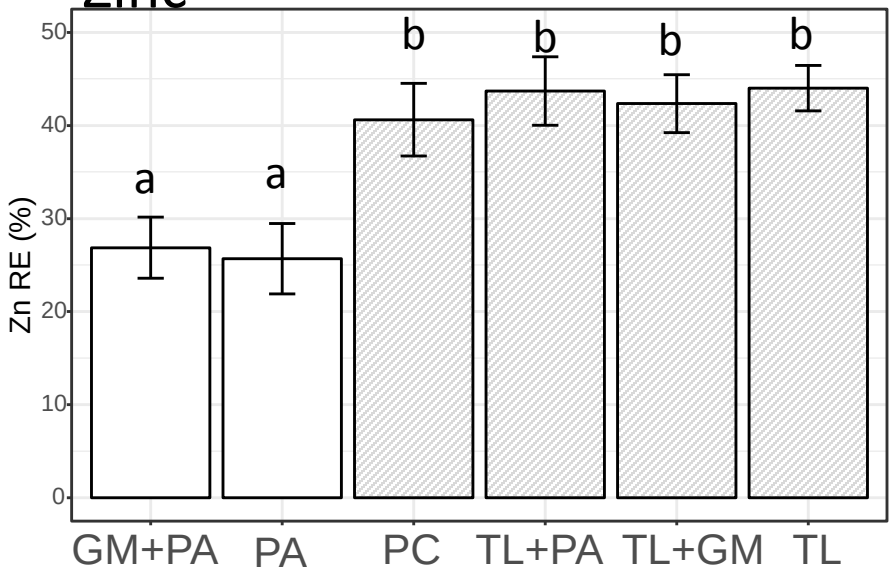
Phosphorus



Copper



Zinc



Abbreviations:

GM: *G. maxima*

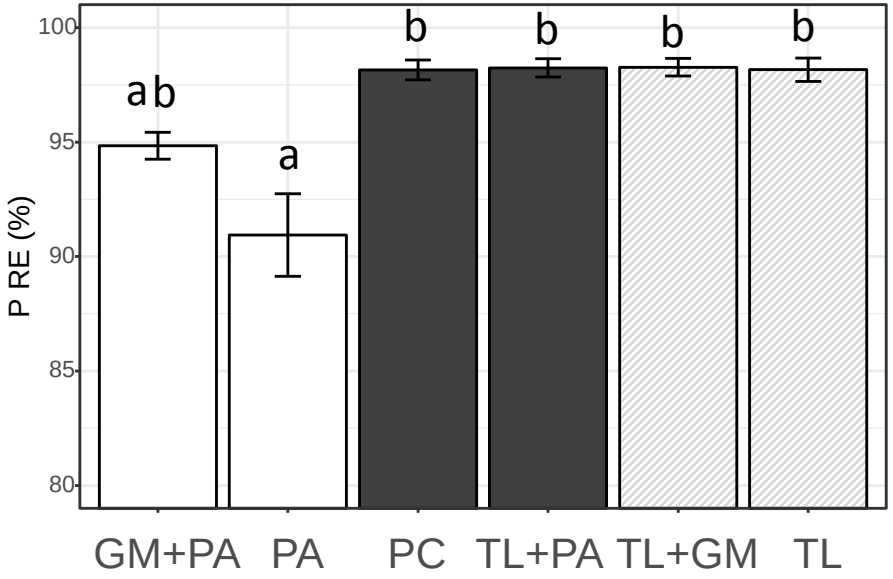
PA: *P. australis*

TL: *T.latifolia*

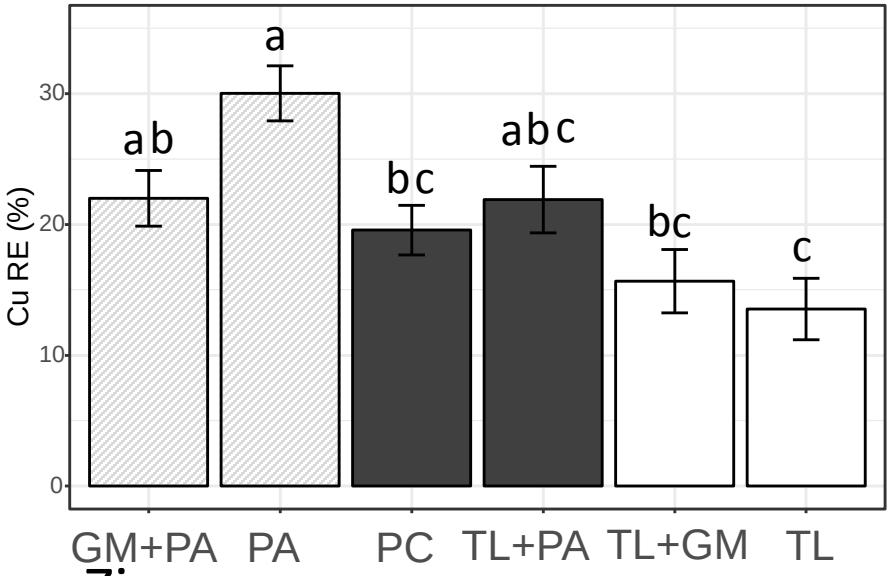
PC*:* Polyculture

Can any plant combinations multi-target?

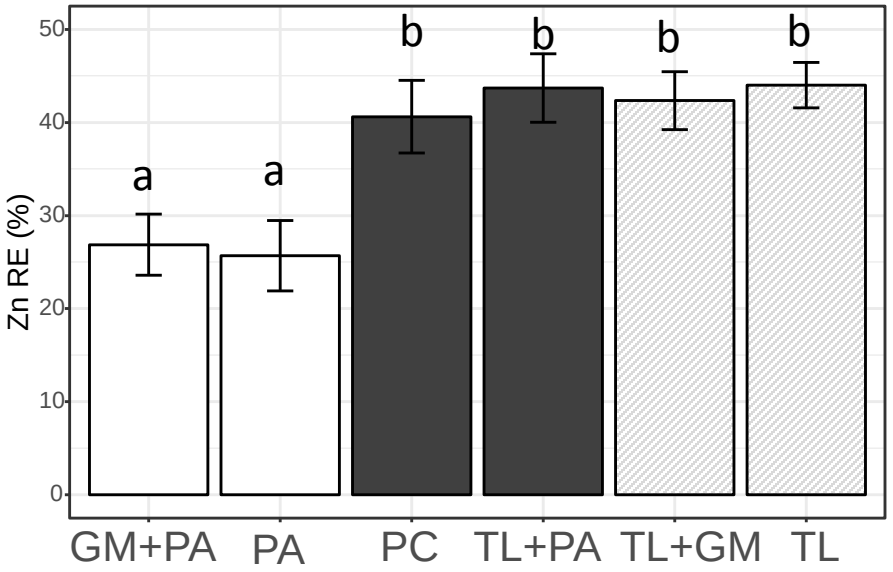
Phosphorus



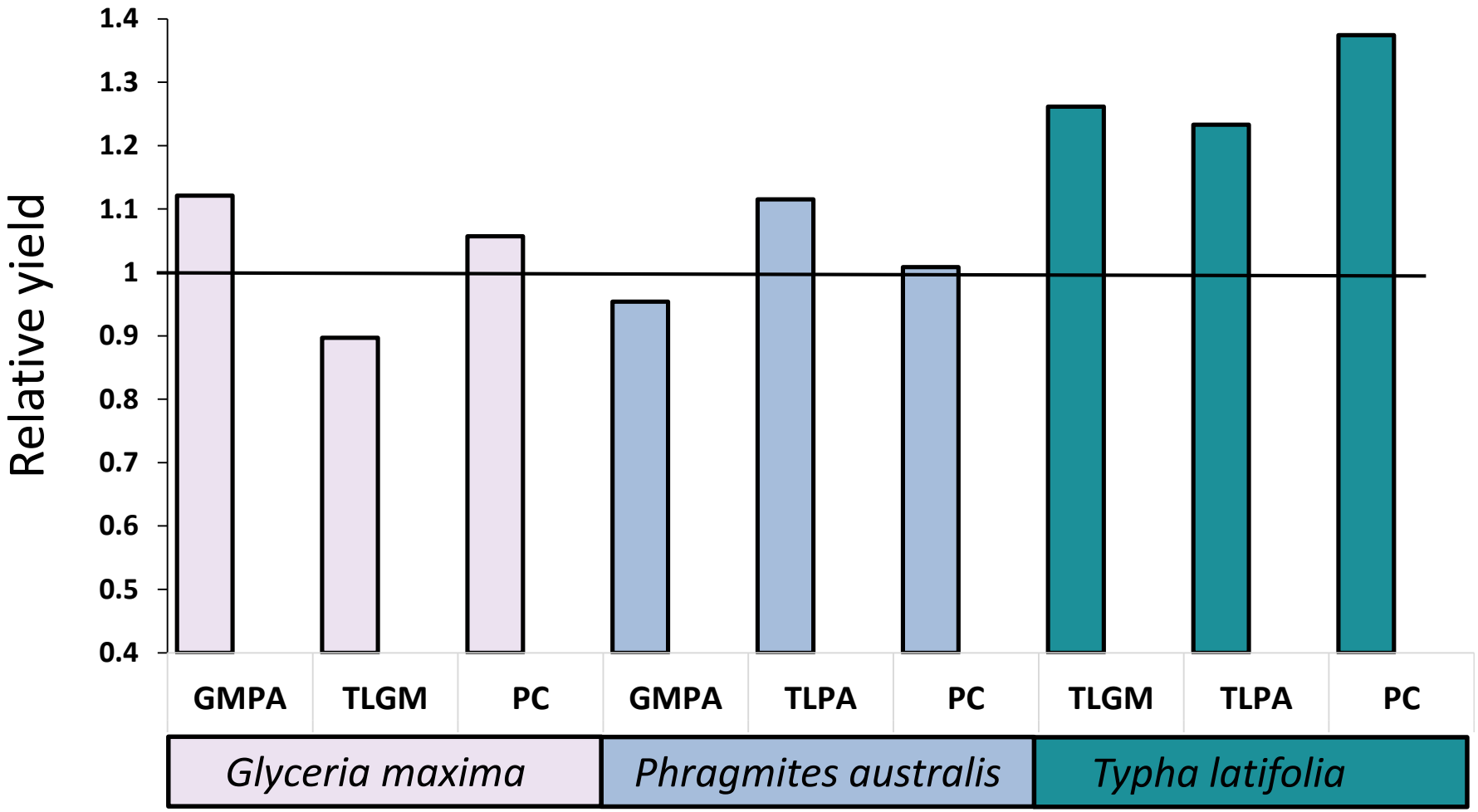
Copper



Zinc



How do species interact?



$$Relative\ yield = \frac{Species\ mean\ realtive\ growth\ (mixture)}{Species\ mean\ realtive\ growth\ (monoculture)}$$

Complementarity

Typha latifolia

Phragmites australis

Conclusions (so far!)

- FTWs are able to reduce diffuse pollutants at varying rates, but thresholds exist (e.g. Cu)

- Evidence for assembling combinations of macrophytes that can remove multiple pollutants (e.g. *Typha latifolia & Phragmites australis*, polyculture)

- Species interactions can be positive offering 'win-wins'

Acknowledgments

Scottish Government gov.scot
Hydro Nation Scholars Programme

UNIVERSITY OF STIRLING

ESHH Environmental Sustainability & Human Health

Thanks to:

Academic colleagues
Technical support staff
Gardens and grounds staff

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