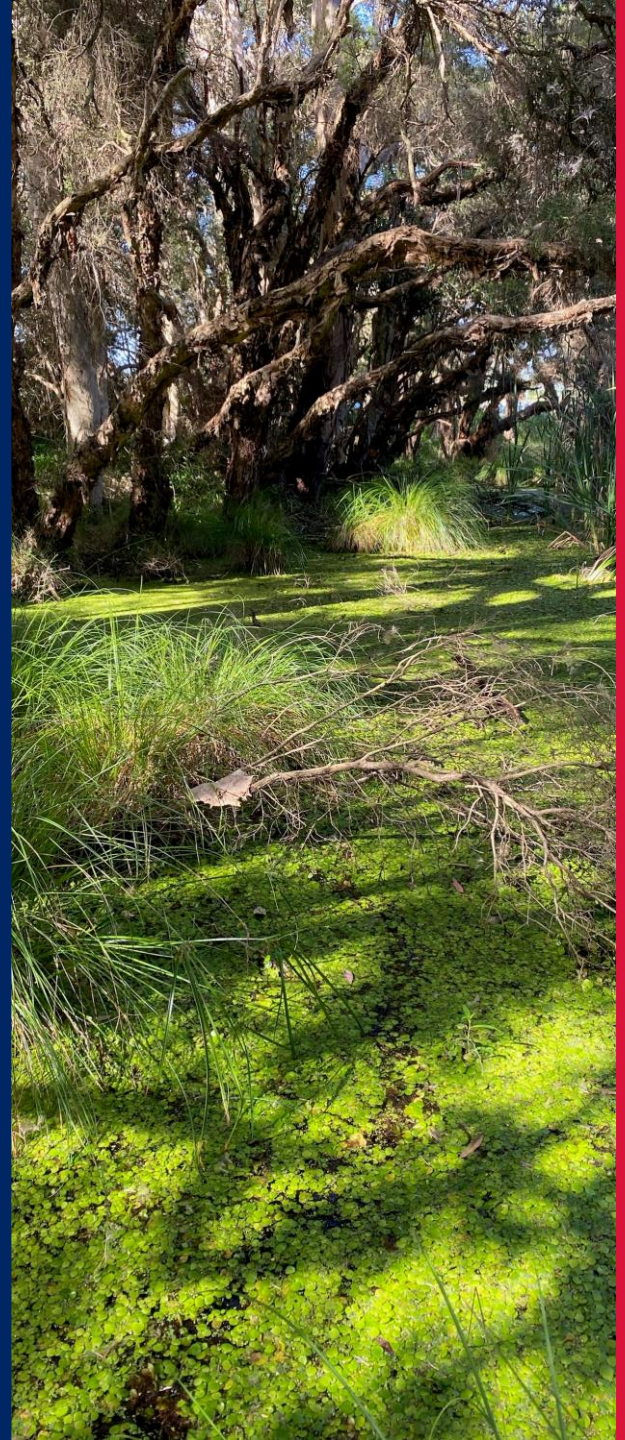
Department of Primary Industries
and Regional Development

Persistence and decay of environmental DNA in freshwater and the implications for weed biosecurity



Karen Bell, Xiaocheng Zhu, David Gopurenko, and Hanwen Wu

19th February 2025, 2nd Australian & New Zealand Environmental DNA Conference

NSW GOVERNMENT

Application of eDNA for aquatic weed biosecurity

High sensitivity

Early detection increases chance of eradication

Challenge: persistence of eDNA following successful eradication may lead to false alarms and unnecessary follow up treatments

Question: How long does eDNA persist following successful eradication?


weeds.brisbane.qld.gov.au


daf.qld.gov.au

How long can eDNA be expected to persist following successful eradication?

- Depends on target organism and starting quantity
- Depends on environmental conditions, e.g., pH, temperature, UV light, microbial activity
- Decay rates from literature vary by orders of magnitude
- Decay rates may vary over time, e.g., biphasic or Weibull function, rather than first-order exponential
- Most previous work on animals, and usually with complete removal of target organism

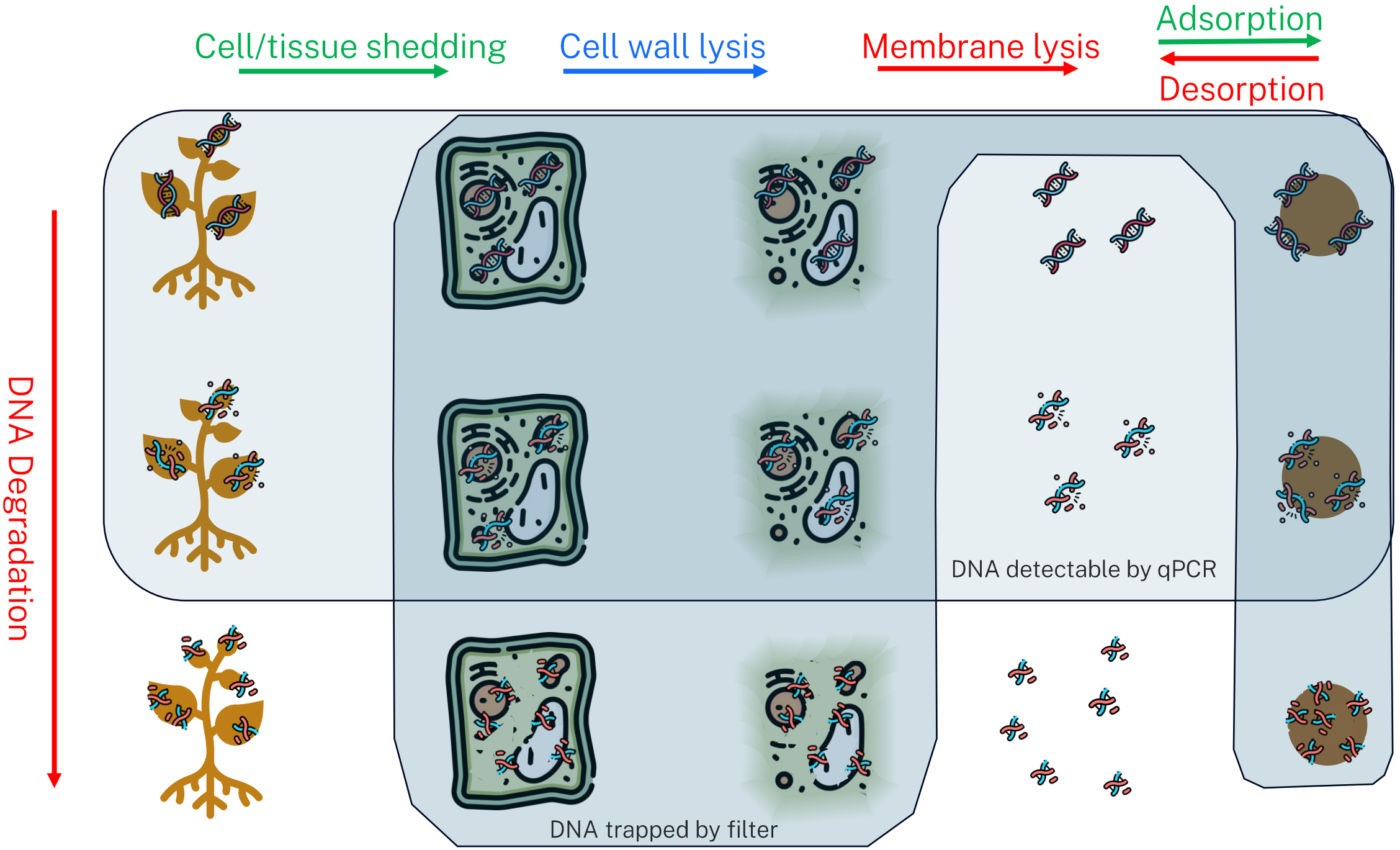
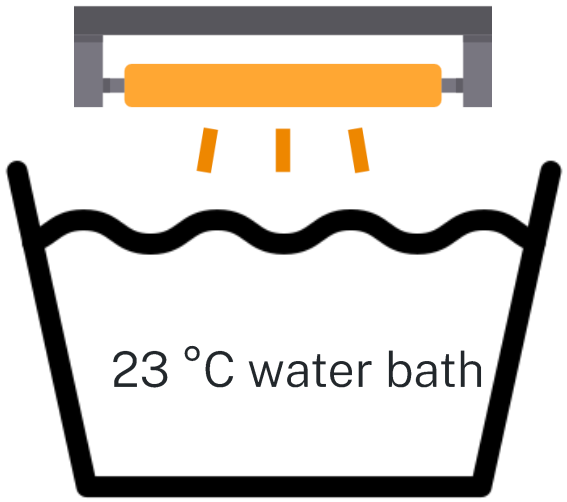


Illustration produced with images from Flat Icon

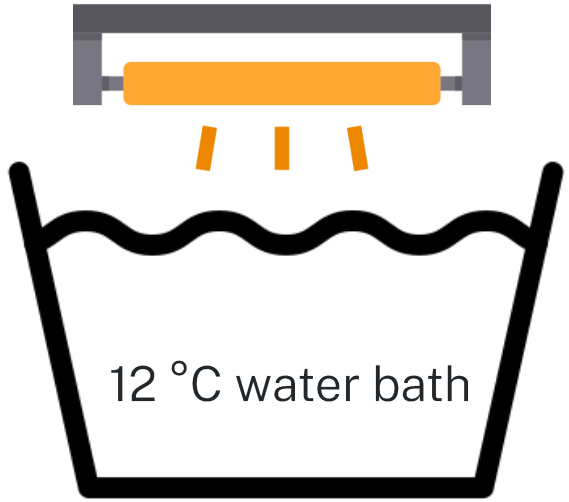
Simulated summer

14:10 light: dark



Simulated winter

10:14 light: dark



Deionised water
Negative control

0.45 µm PES
5 µm PES

3x deionised water
+ 1 g frogbit tissue

0.45 µm PES
5 µm PES

3x lake water
+ 1 g frogbit tissue

5 µm PES

Deionised water
Negative control

0.45 µm PES
5 µm PES

3x deionised water
+ 1 g frogbit tissue

0.45 µm PES
5 µm PES

3x lake water
+ 1 g frogbit tissue

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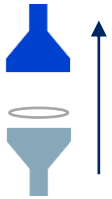
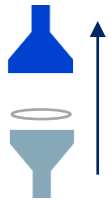
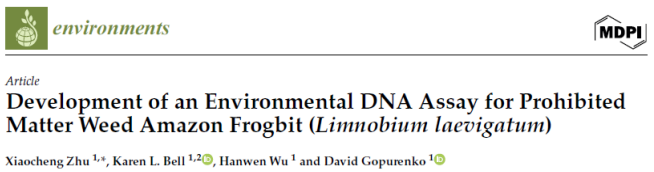




QIAGEN DNeasy
blood & tissue kit

↓

Species-specific &
universal QC assays

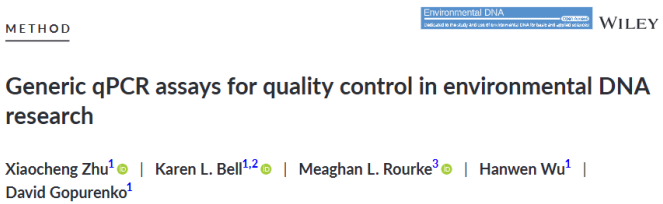

environments

MDPI

Article

Development of an Environmental DNA Assay for Prohibited Matter Weed Amazon Frogbit (*Limnobium laevigatum*)

Xiaocheng Zhu [1,*], Karen L. Bell [1,2], Hanwen Wu [1] and David Gopurenko [1]


METHOD

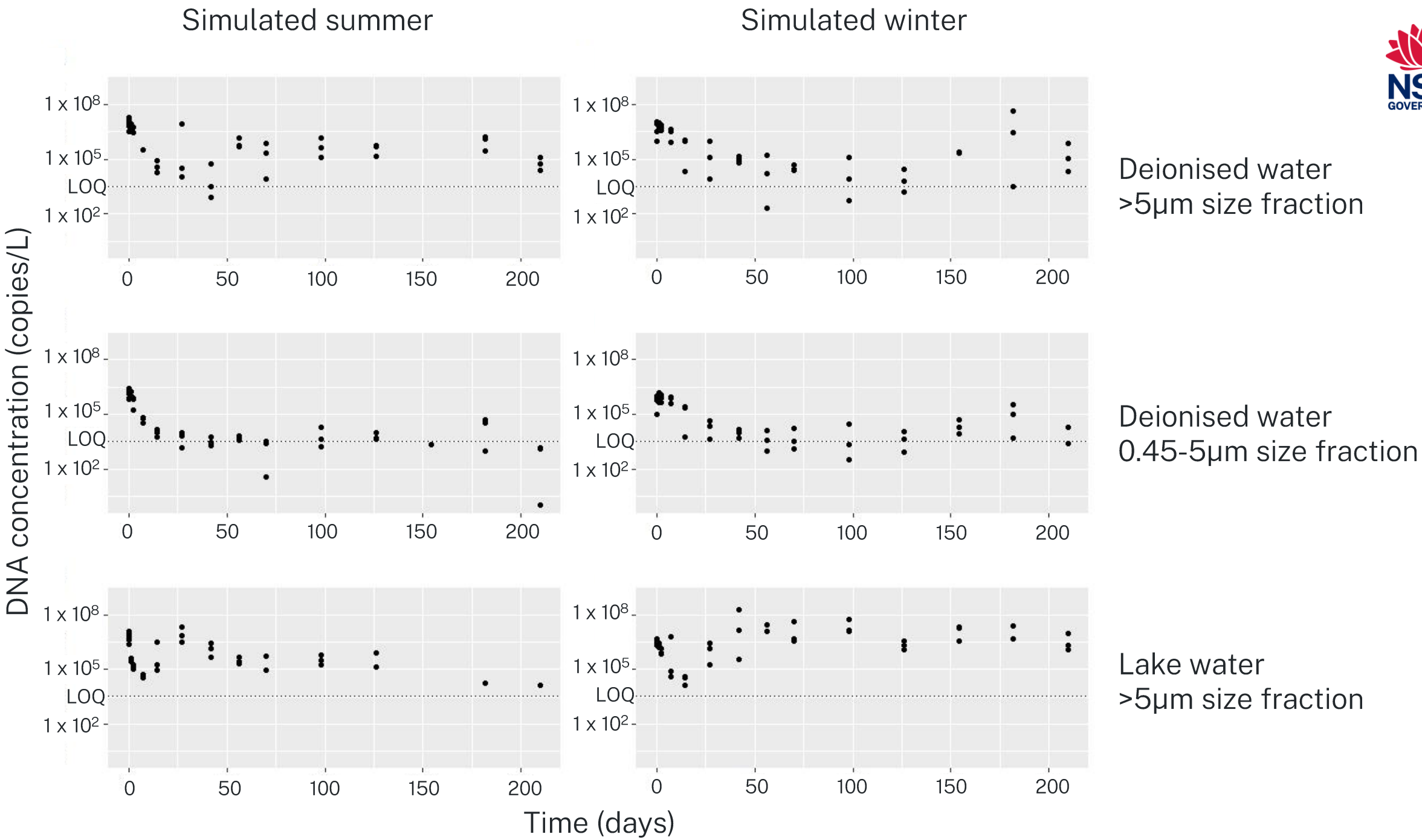
Environmental DNA

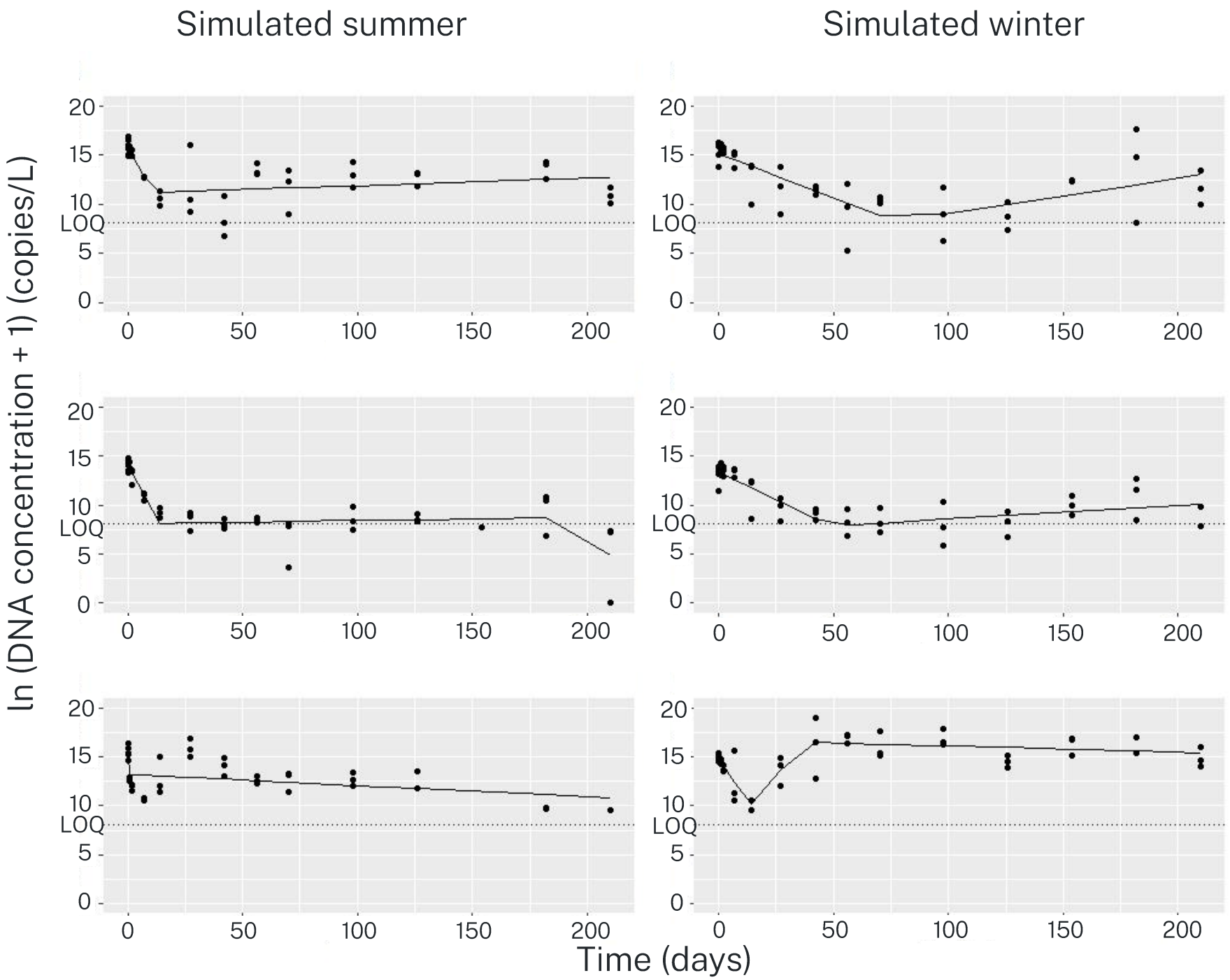
WILEY

Generic qPCR assays for quality control in environmental DNA research

Xiaocheng Zhu[1] | Karen L. Bell[1,2] | Meaghan L. Rourke[3] | Hanwen Wu[1] | David Gopurenko[1]

Illustration produced with images from Flat Icon


Simulated summer
Simulated winter
DNA concentration (copies/L)
1 x 10^8
1 x 10^5
LOQ
1 x 10^2
0
50
100
150
200
Time (days)
Deionised water
>5µm size fraction
Deionised water
0.45-5µm size fraction
Lake water
>5µm size fraction



Deionised water
>5µm size fraction

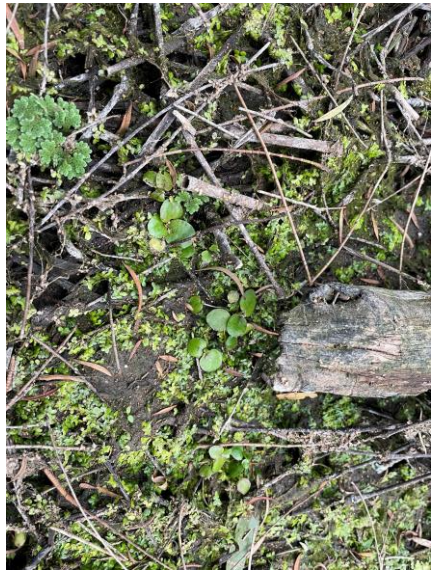
Deionised water
0.45-5µm size fraction

Lake water
>5µm size fraction

Comparison to the field (small ponds & lagoons)

Oakville
Nov 2024

Catherine
Field
Jun 2023



Catherine
Field
Sep 2024

Oakville:

- No plants observed for 8 months (1 seedling in January 2024)
- 5 of 5 samples positive (1.506 x 10^6 copies/L)

Catherine Field:

- Density substantially reduced
- 4 of 4 samples positive (4.167 x 10^6 copies/L)

Comparison to the field (intermittently flowing streams)

Corrimal Nov 2023

Corrimal Sep 2024

Bomaderry July 2023

Bomaderry Sep 2024

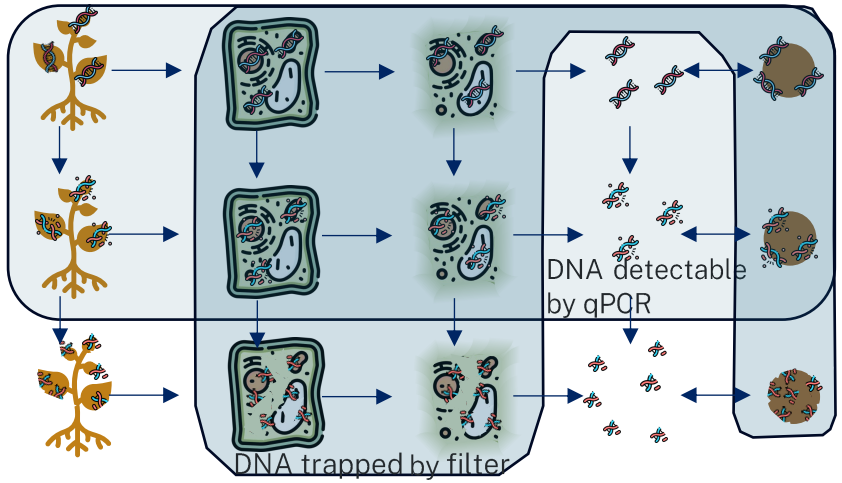
Corrimal:

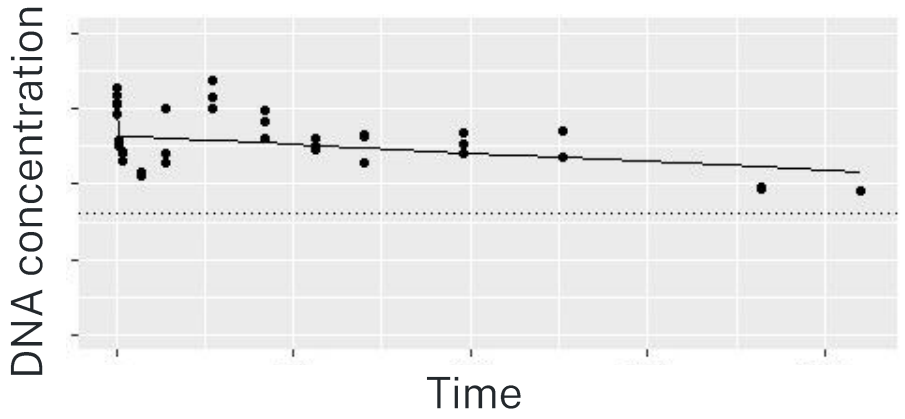
- Last plants observed 8 months before sampling
- 6 of 6 samples positive

Bomaderry:

- Approx. 40 plants on day of sampling
- 3 of 4 samples positive at upper end of infestation (151.1 copies/L)
- 5 of 5 samples positive at lower end of infestation (2.610×10^5 copies/L)

What have we learnt so far?





- eDNA from dead plant tissue does not decrease with first-order exponential decay
- eDNA is persistent in the laboratory and the field, especially in ponds & lagoons
- eDNA decays faster in deionised than lake water

NSW GOVERNMENT

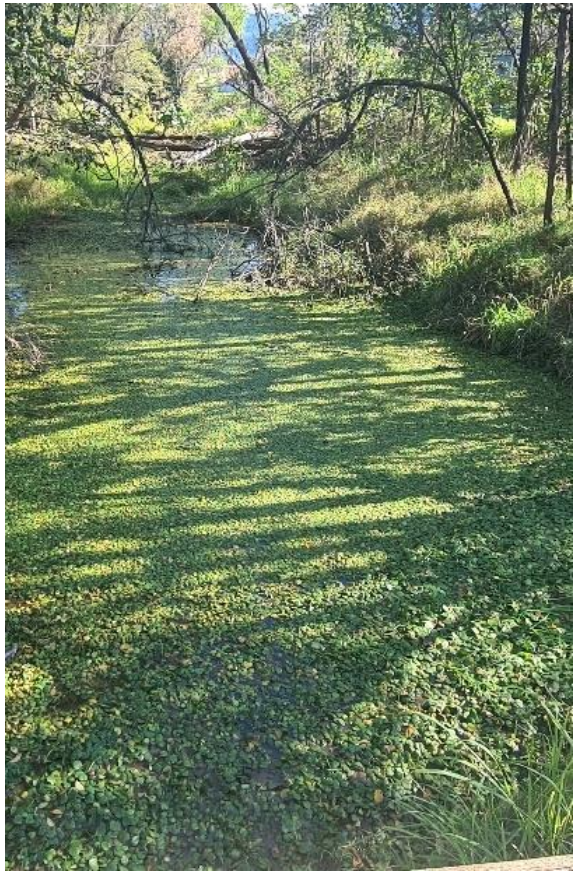
What does this mean for eDNA use in surveillance and eradication programs?

Good news for detecting and delimiting new infestations:

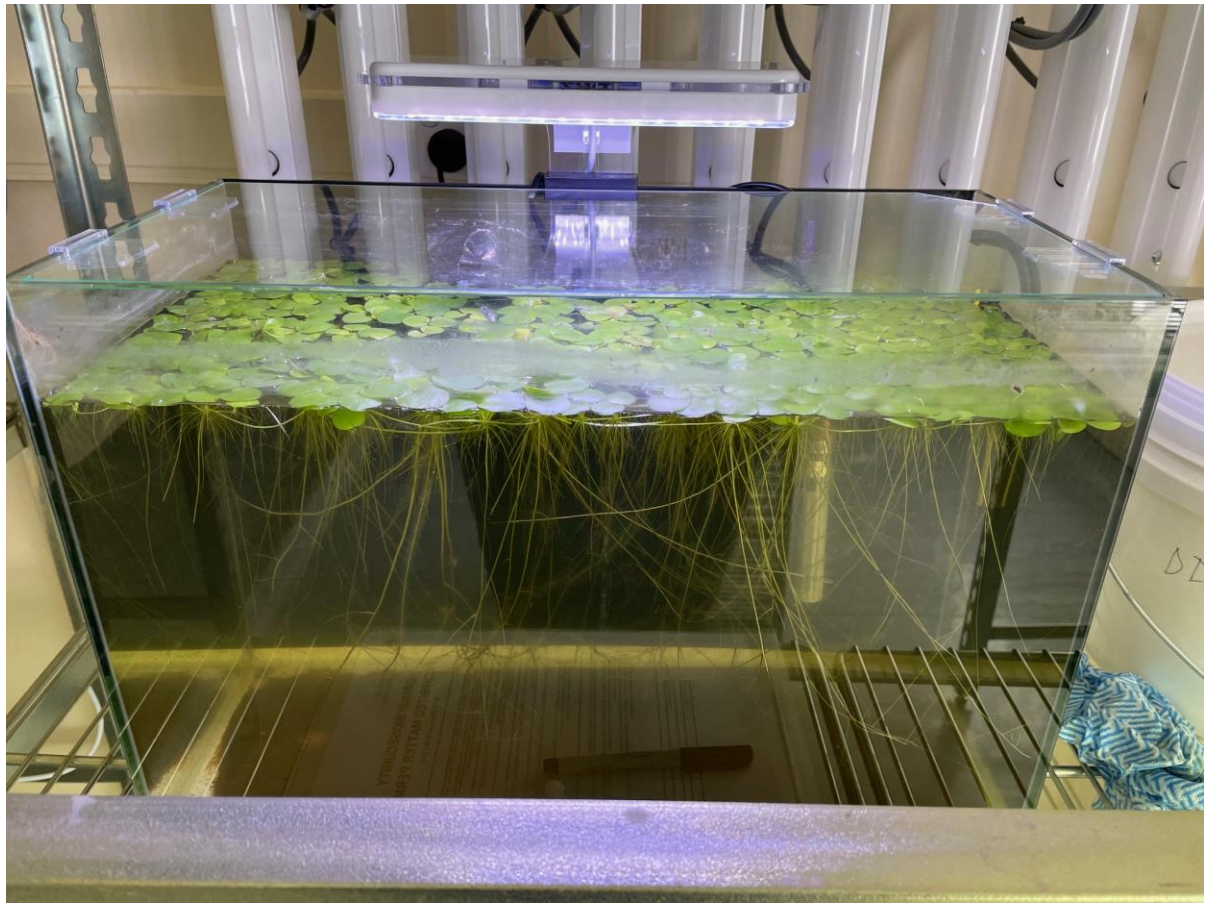
- eDNA persistence increases chance of detection
- Field work has shown that eDNA is always detected when frogbit is present within water body
- Frogbit eDNA can also be detected downstream from an infestation (exact distance TBC)

More work needed before use in confirmation of eradication:

- eDNA may be present for a long time after plants have been successfully treated
- Cannot distinguish eDNA from re-emergence vs historical eDNA



Future research directions



Effect of sediment and microbes in lake water

eDNA decay as a function of multiple co-occurring processes

Distinguishing re-emergence from historical eDNA:

- eRNA
- Long-fragment eDNA
- Xiaocheng (Diego) Zhu's talk Thursday 11:20am

Acknowledgements

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QLD Department of Agriculture and Fisheries

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Shoalhaven Council

Illawarra-Shoalhaven Joint Organisation

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Thank you

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