EDITH COWAN UNIVERSITY

GOVERNMENT OF WESTERN AUSTRALIA

Department of Biodiversity, Conservation and Attractions

Chasing Flamingos

Tracking synthetic DNA movement in a river

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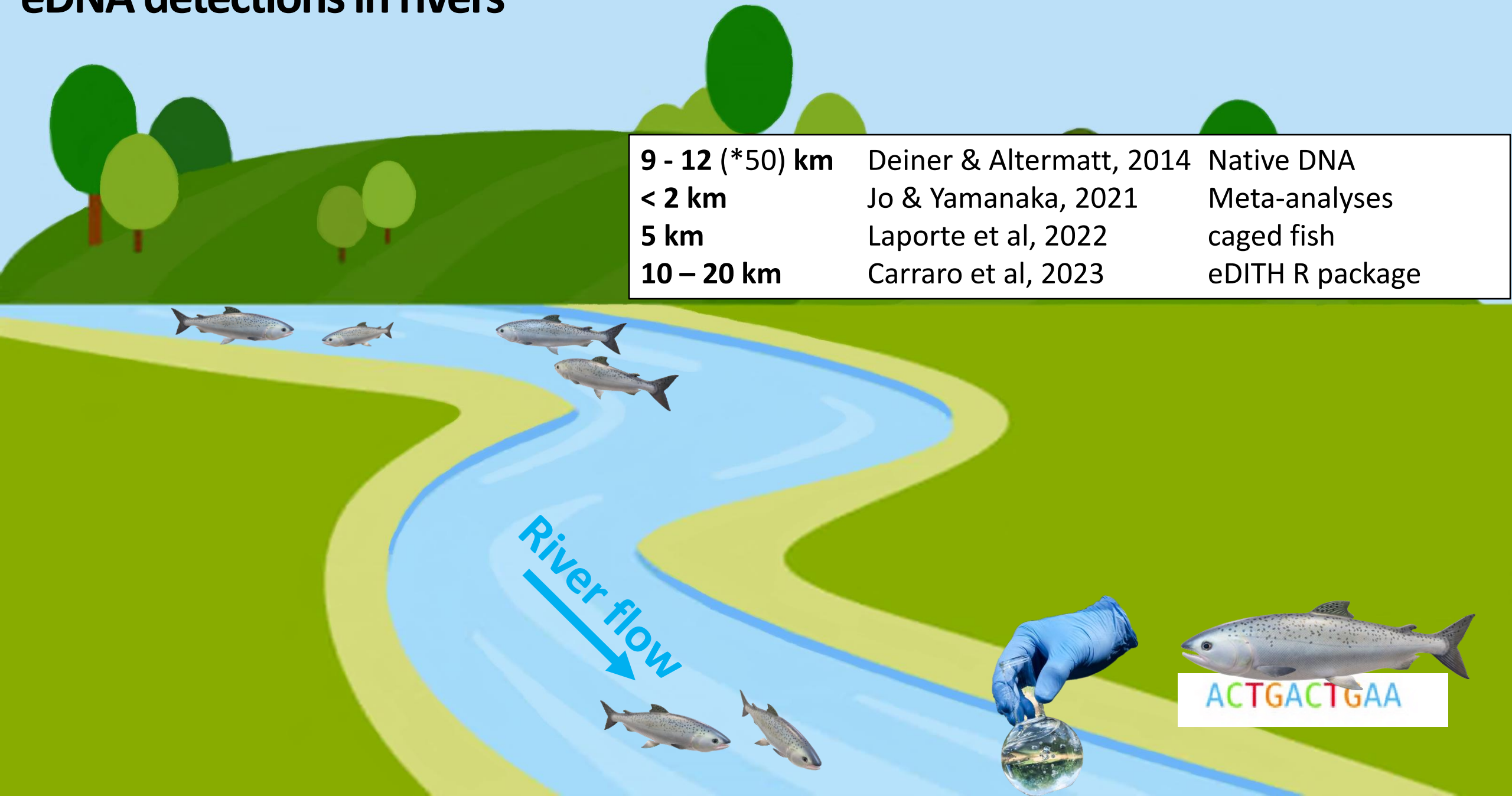
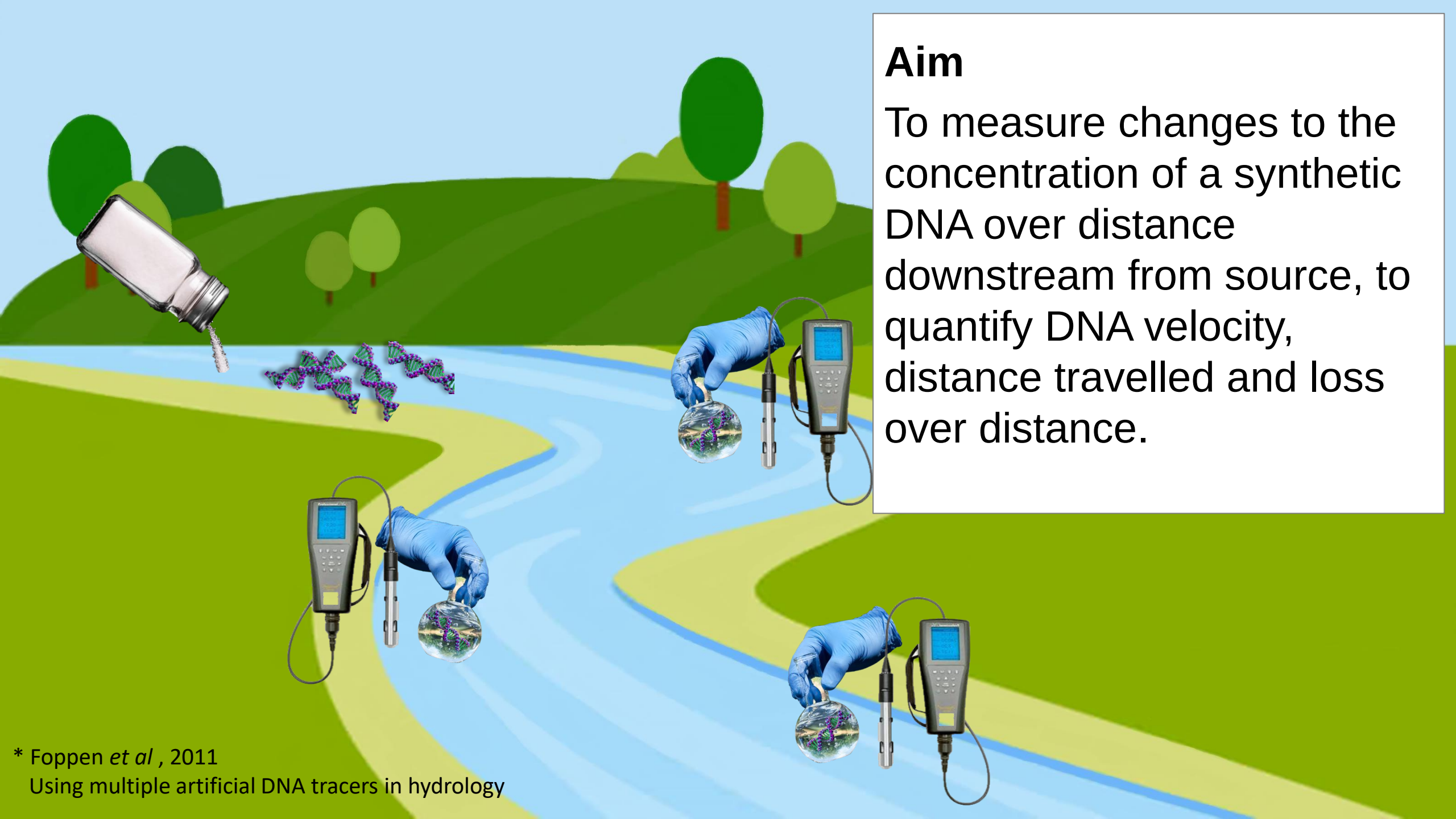
eDNA detections in rivers

9 - 12 (*50) **km**	Deiner & Altermatt, 2014	Native DNA
< 2 km	Jo & Yamanaka, 2021	Meta-analyses
5 km	Laporte et al, 2022	caged fish
10 – 20 km	Carraro et al, 2023	eDITH R package





Aim

To measure changes to the concentration of a synthetic DNA over distance downstream from source, to quantify DNA velocity, distance travelled and loss over distance.

* Foppen *et al* , 2011
Using multiple artificial DNA tracers in hydrology

Experiment zone

- Southern River, Perth
- 1.4 km
  - water level gauges
  - Discharge measurements upstream and downstream
- Optimal flow rates for experiment
- Volume of experiment reach

DNA design

gBlock gene fragment
- Integrated DNA Techno
- Double strand
- < 1,000 bp

Template DNA + **Random DNA sequence** = **synthetic DNA**

American flamingo
(*Phoenicopterus ruber*)
Cytochrome B

CGCGCACCTTCTTAATCTAC
CCACTGGTTCTGCATGTAAC
ATGCGCCAGCTTCTAACTAC
CGGACAACCGCAGTTACTAC
CCCACGCTGCACTGTAATAC
GTAGATTAAGGGTCTGGATC

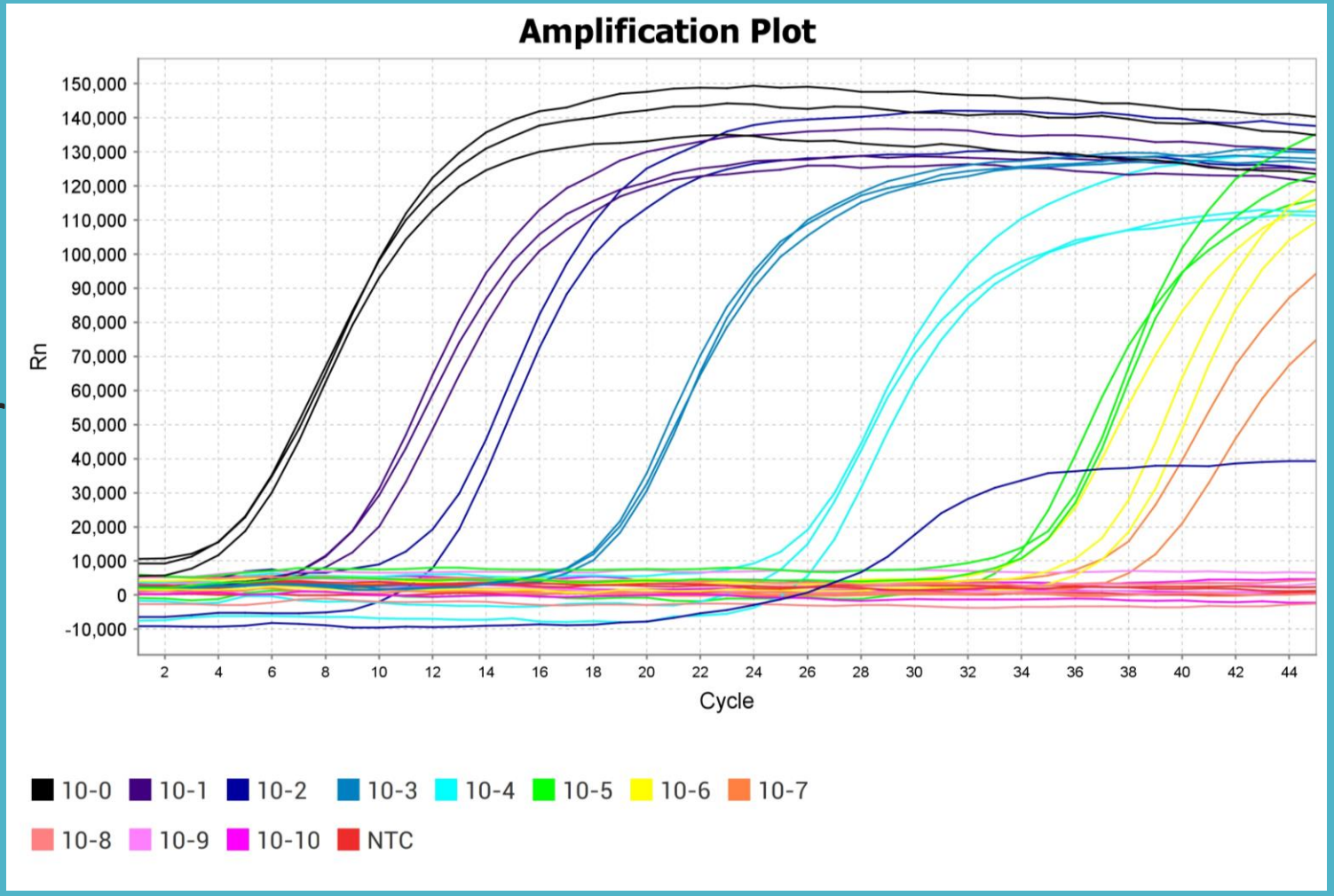
Design New Primers

Fake flamingo
(*Phoenicopterus plastica*)

Test DNA

1) In silico testing
   - ➢ Uniqueness
   - ➢ Check for complex structur

2) In vitro specificity testing:
   - ➢ Select best primers
   - ➢ Optimise assay
   - ➢ Assay sensitivity



97,000 copies /L river = 581 trillion

Salt

100 kg in 450 L

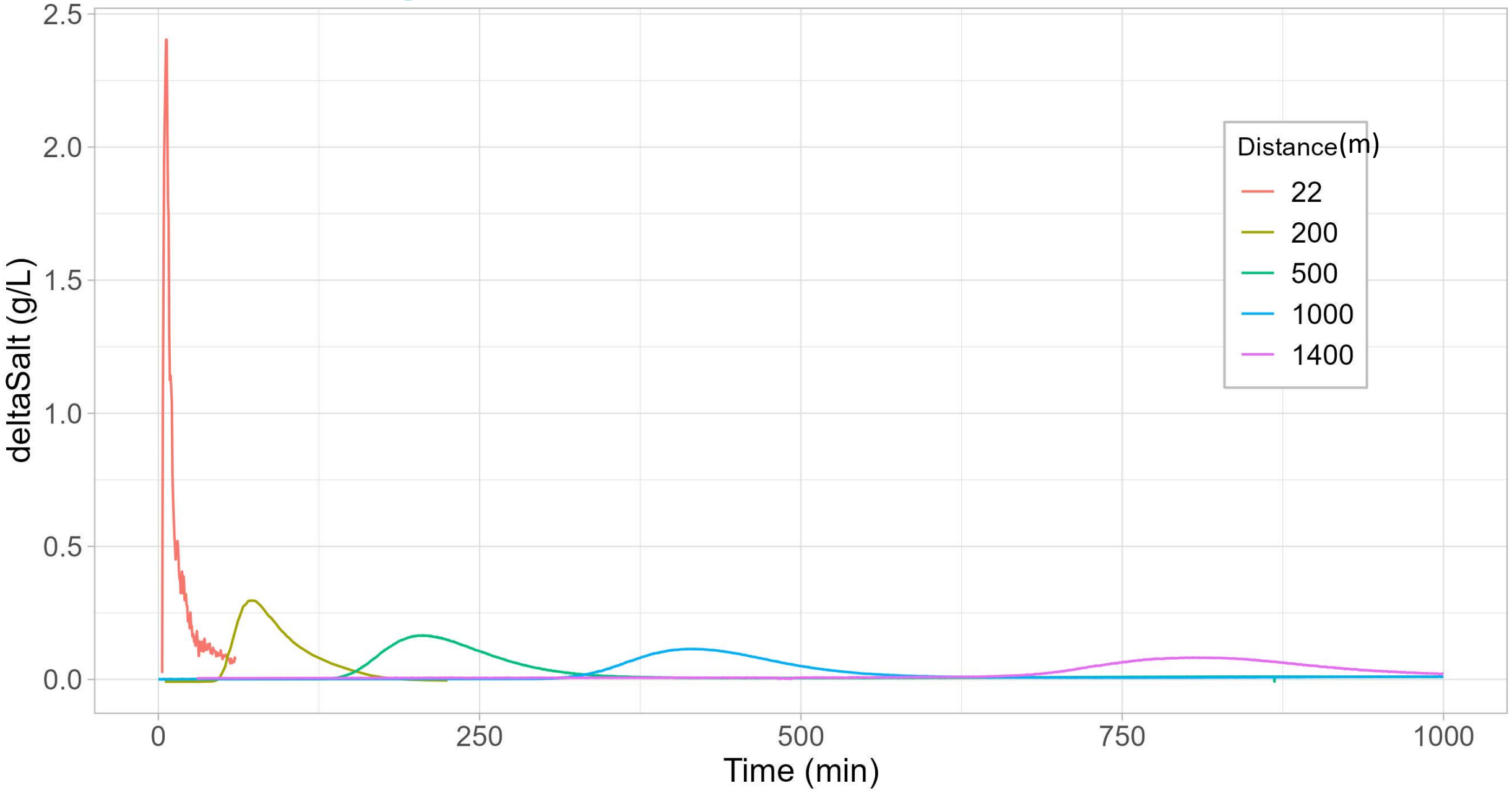
Fake Flamingo DNA

2.8 quadrillion copies

Tracking salt and flamingos

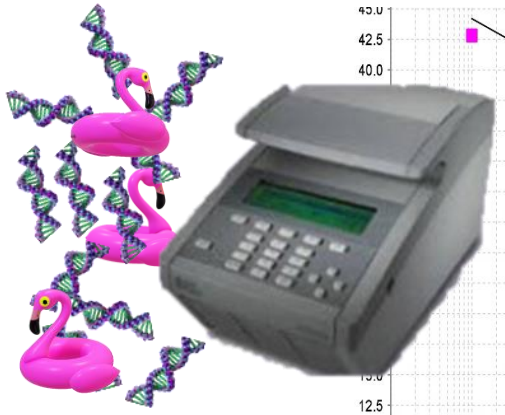
- 3 teams + 2 rovers
- 3 x YSI ProDSS
- 4 x solinist EC loggers
- 2 x autosamplers

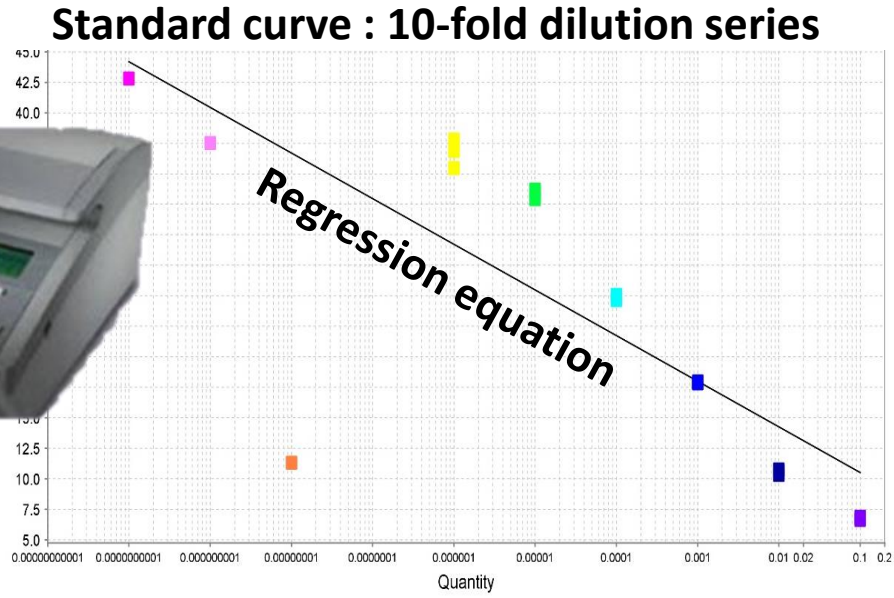
Salt tracking



Catching and counting flamingos

Sample water → **Filter** → **Extract DNA** → **Amplify DNA** → **Quantify DNA**





DNA copies / L river water

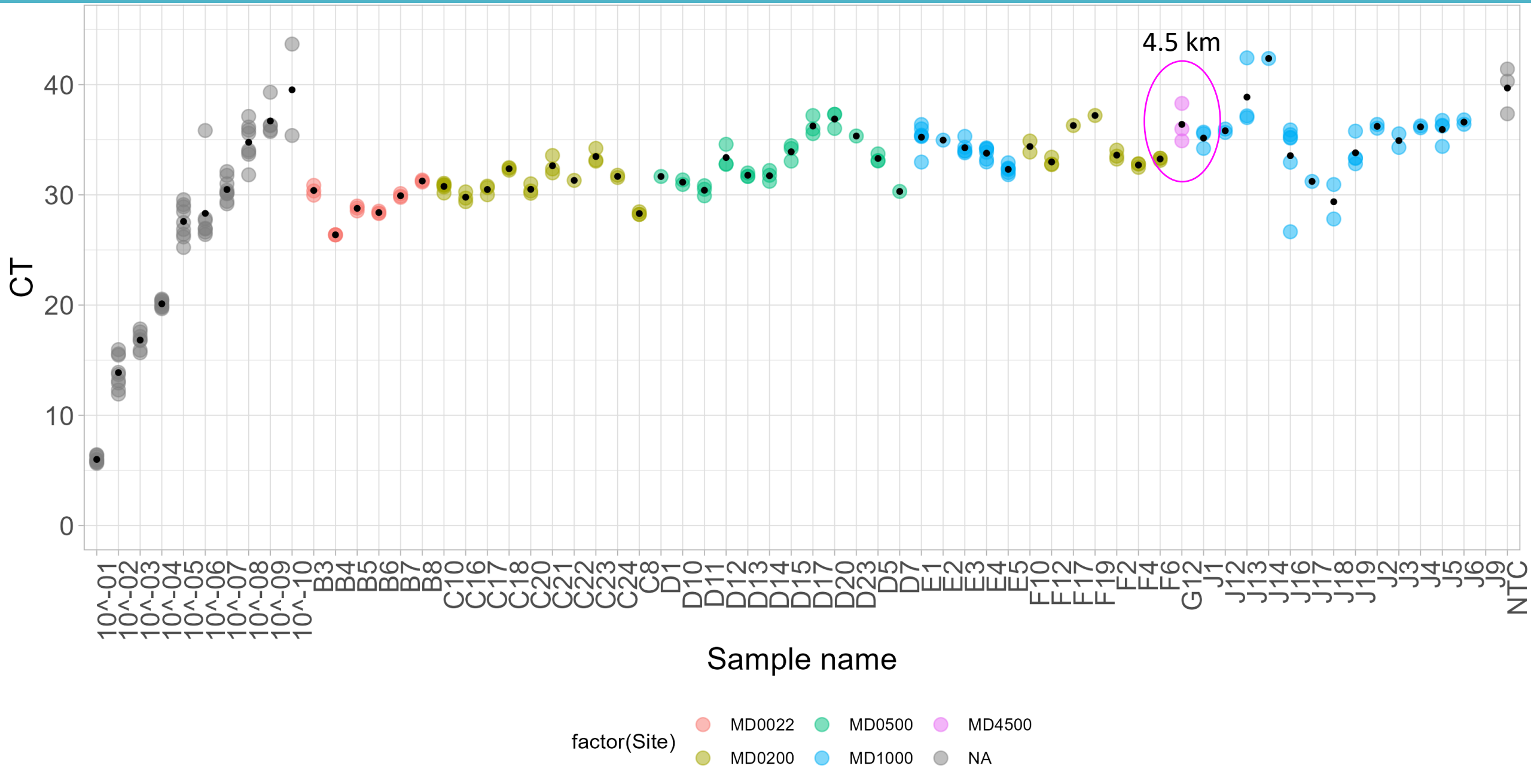
Volume filtered

Extract volume

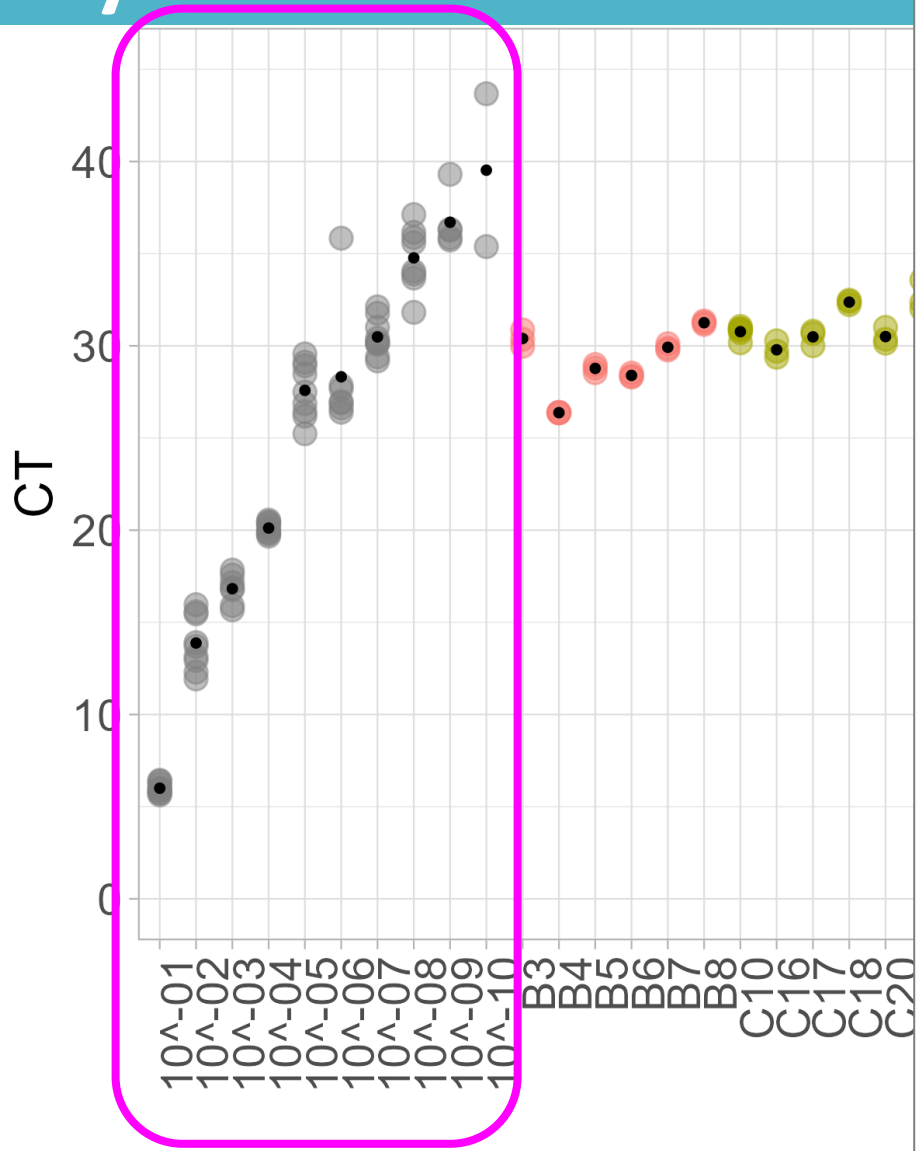
2 uL

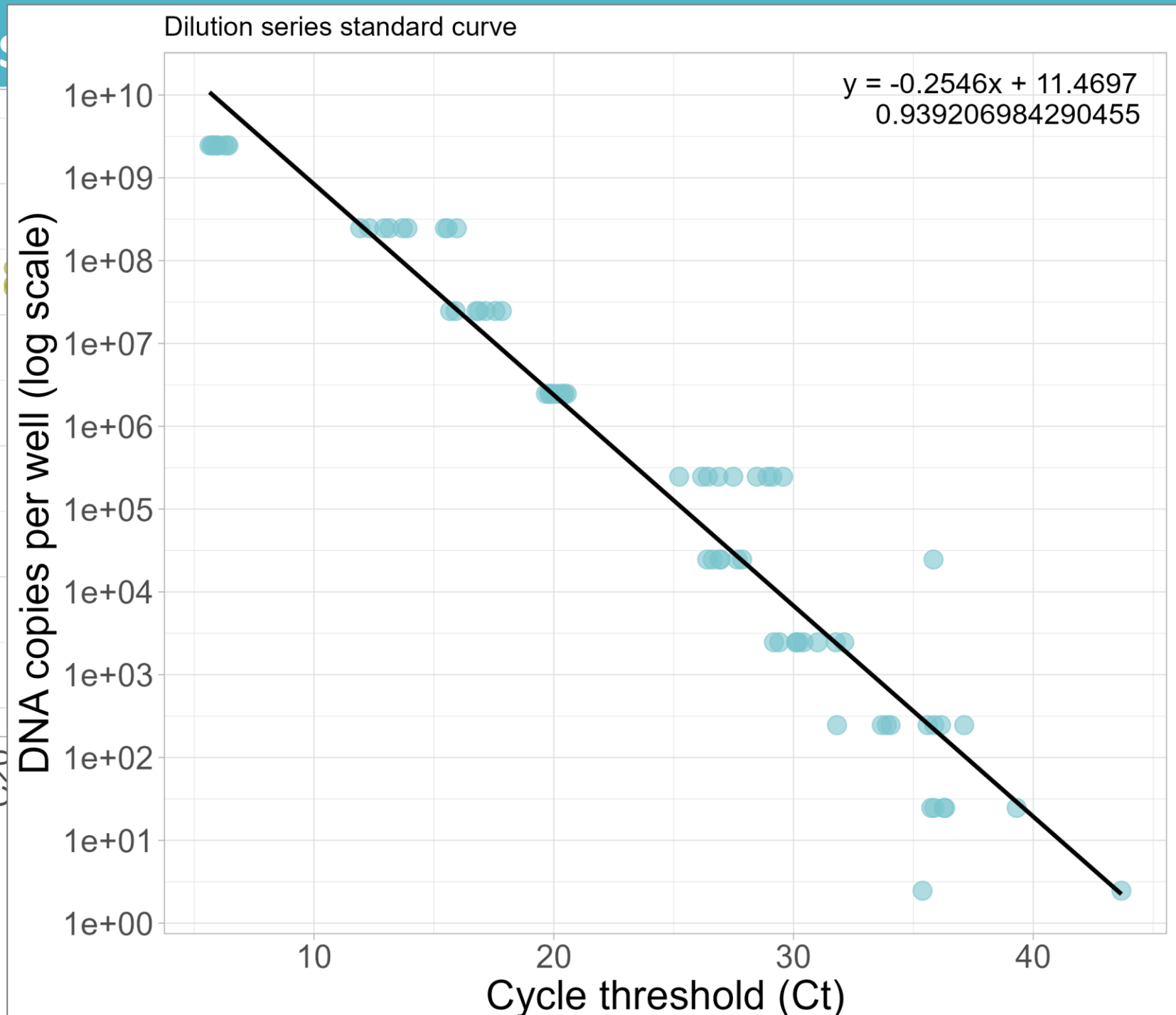
Ct → DNA copies in well

Cycle threshold results

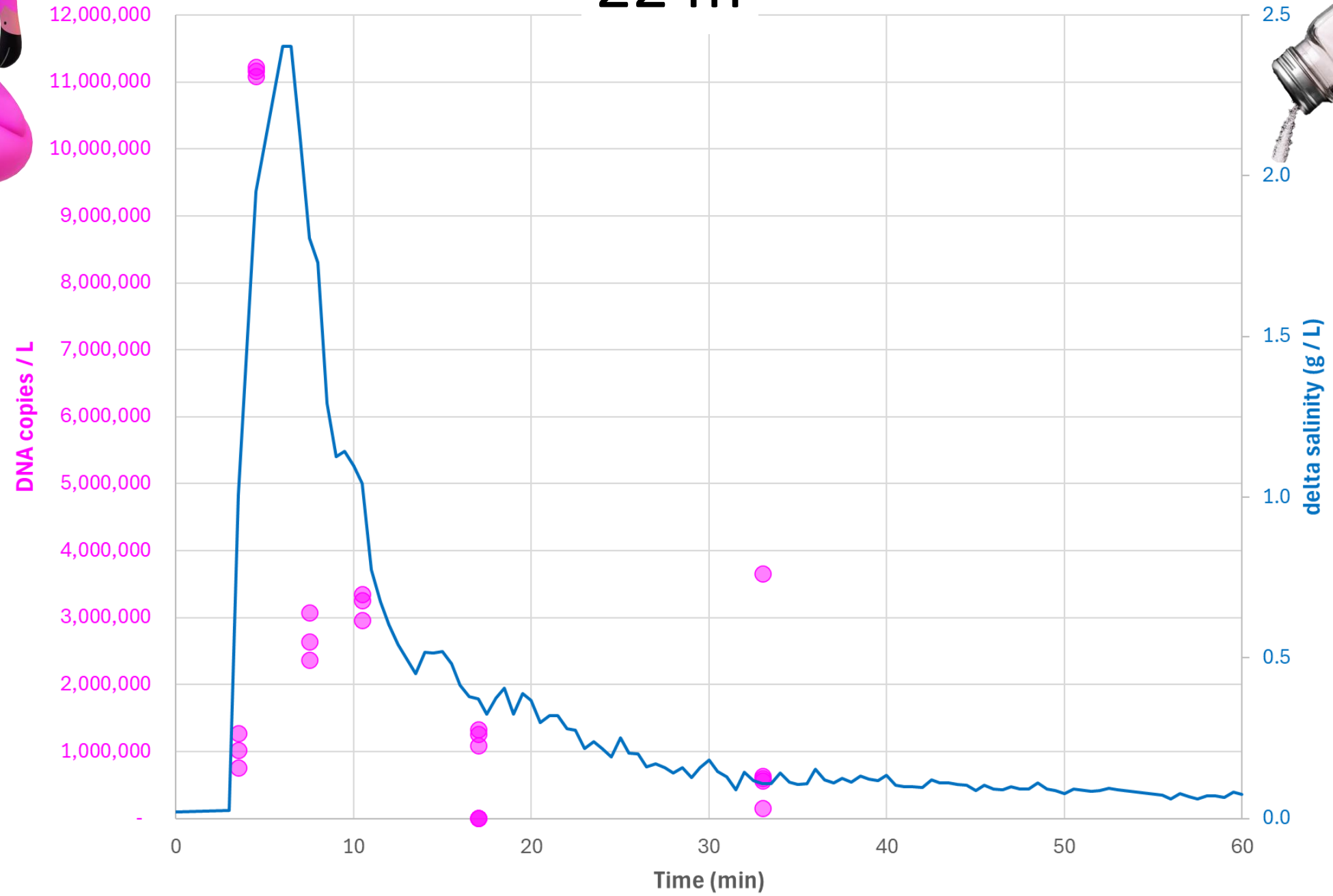


Cycle threshold results

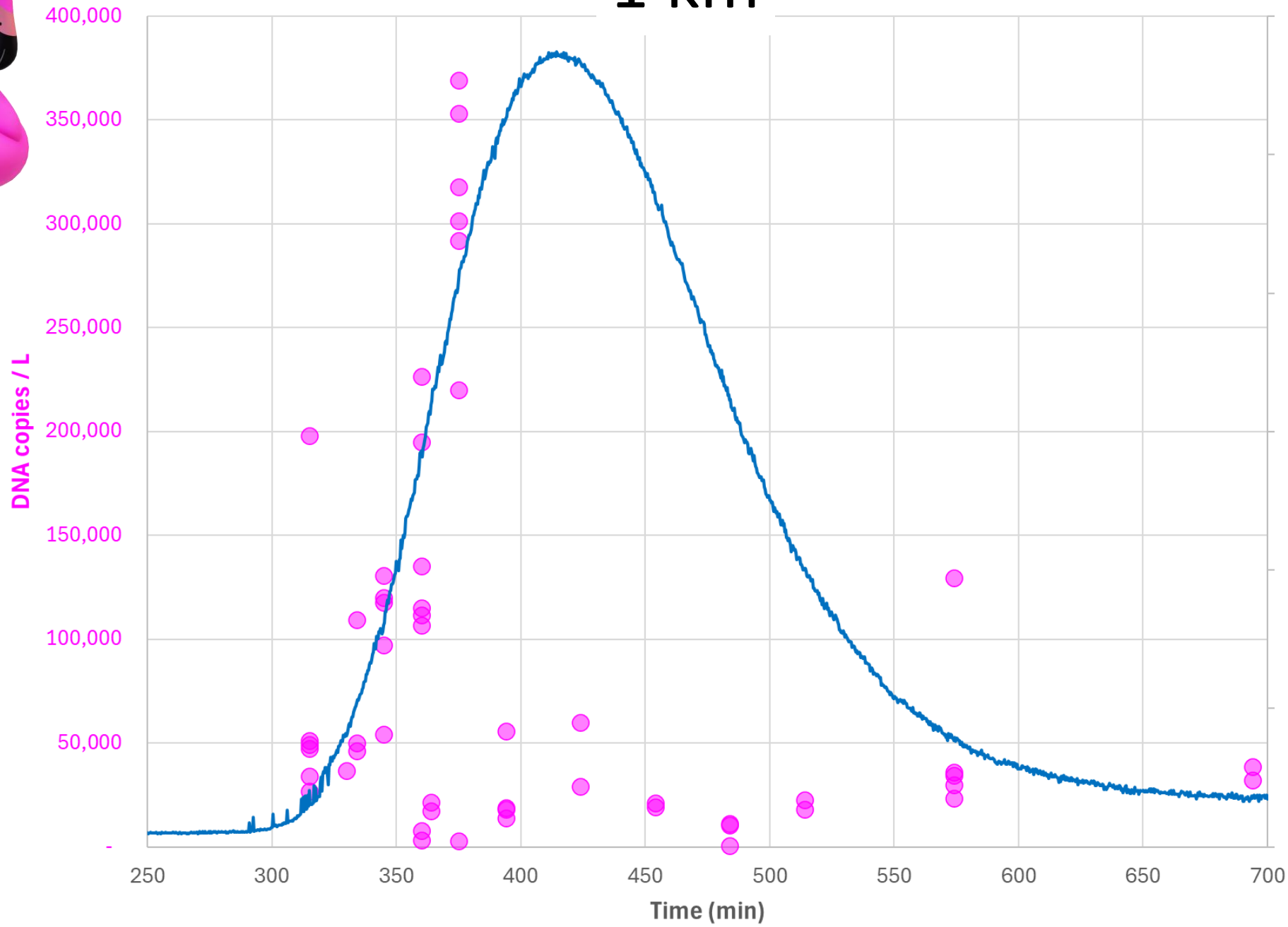




22 m


12,000,000
11,000,000
10,000,000
9,000,000
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
-
DNA copies / L
2.5
2.0
1.5
1.0
0.5
0.0
delta salinity (g / L)
0
10
20
30
40
50
60
Time (min)

1 km


400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
-
DNA copies / L
0.12
0.10
0.08
0.06
0.04
0.02
0.00
delta salinity (g / L)
250
300
350
400
450
500
550
600
650
700
Time (min)

Key findings to date:

DNA is highly variable

- Further investigation into CT analysis and treatment of variation between replicates.

DNA dispersal differs to salt

- Will investigate potential causes

DNA detected 4.5 km downstream

- where salt was detected at near background salinity.
- Indicates that DNA may be a more sensitive hydrological tracer.

Next steps

Reactive Transport model

ReacTran in R :

One-dimension model

- diffusion and advection

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