Can freshwater mussels (*Echyridella* sp.) function effectively as a biological tool for stream restoration?

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Why Kākahi?

- Not charismatic
- Not popular
- Not cuddly
- Not cute

Why are kākahi important?

- Taonga species/highly valued food resource

- Ecosystem health indicator
  - Bio accumulation
  - Obligate parasitic stage

- Bioengineers
  - Bio-turbators
  - Habitat enhancers
  - Filter feeders

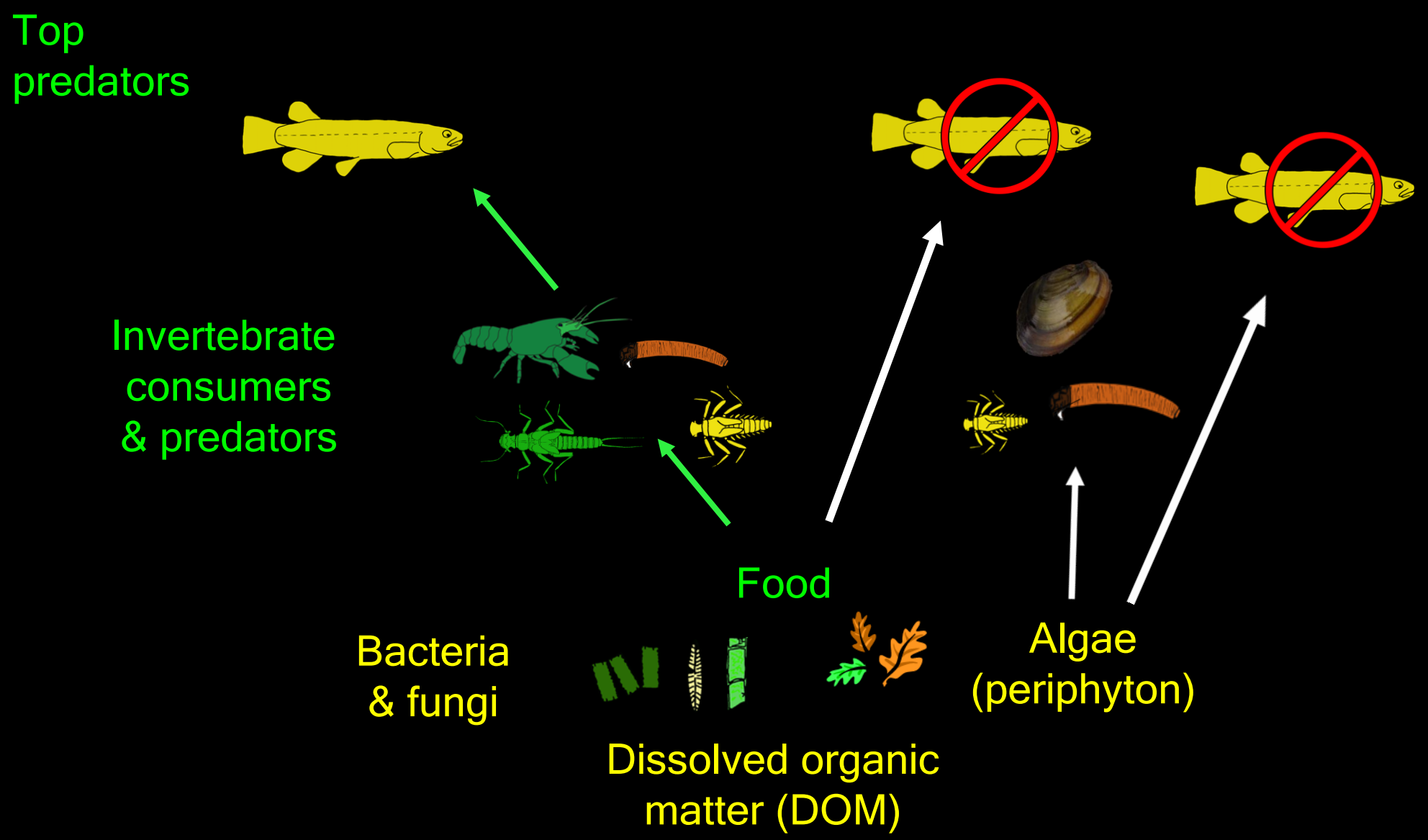
They are in essence the kidneys of our waterways….

New Zealand's Freshwater mussels

Imperilled organisms....

Or the hope for freshwater rehabilitation

New Zealand stream foodwebs



Freshwater mussels (Kākahi) classified as “in decline”

Distribution

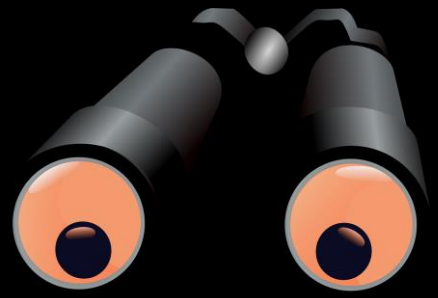
– Very little known about current distribution in lotic environments

– Often not included in fish surveys

– Common invertebrate sampling methods ineffective

In this talk……

Where are they?



Are they “in decline”?

What affects feeding & filtration?

Distribution

Survey – historical/anecdotal accounts

Environmental variables
- e.g Flow, riparian margins, chemistry, habitat, substrate

~25m reach

Distribution

- Historically widely distributed throughout New Zealand
- Current distribution not well known

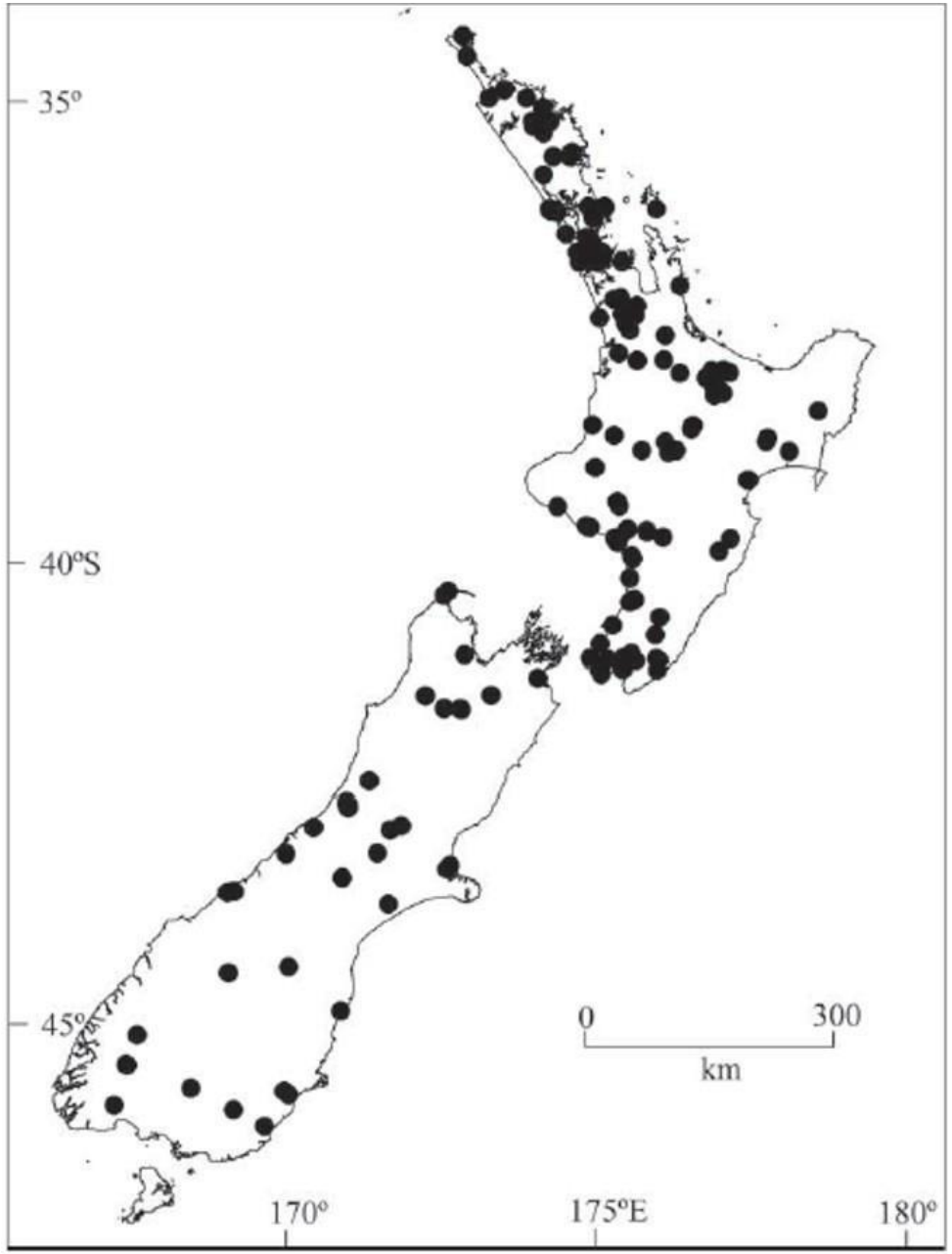


Figure 1. Historical distribution for kākahi (*E.menziesii*) taken from Gray (1843) in Marshall and Fenwick (2014)

Kākahi distribution is in decline

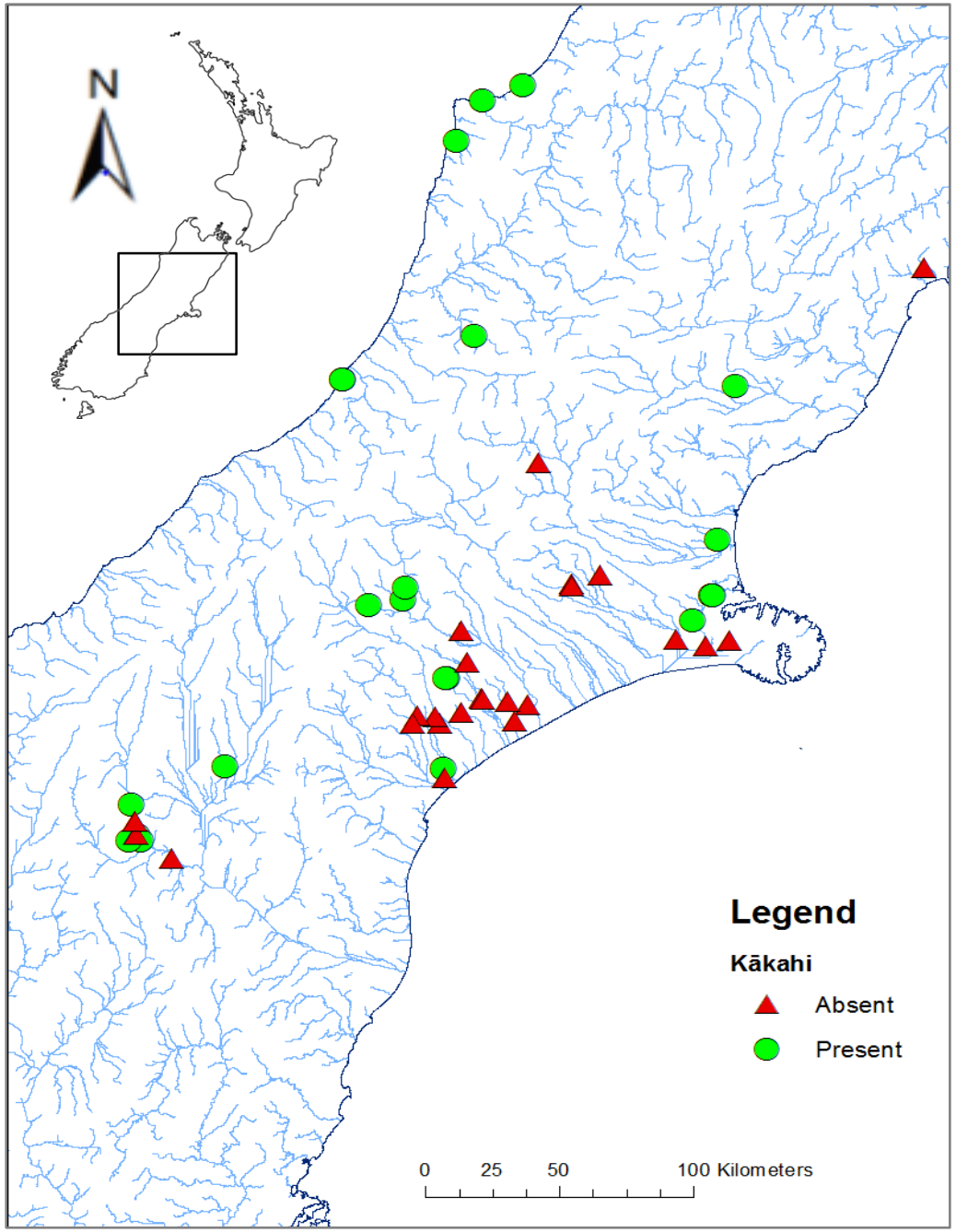
Survey

Sites selected from recorded and anecdotal evidence (yr 2000 cut-off)

43 Sites

22 confirmed for Kākahi

Some previously recorded sites no longer exist



Sites Kākahi present

1st Order - 5th Order



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Sites Kākahi absent

Population structure

Survey

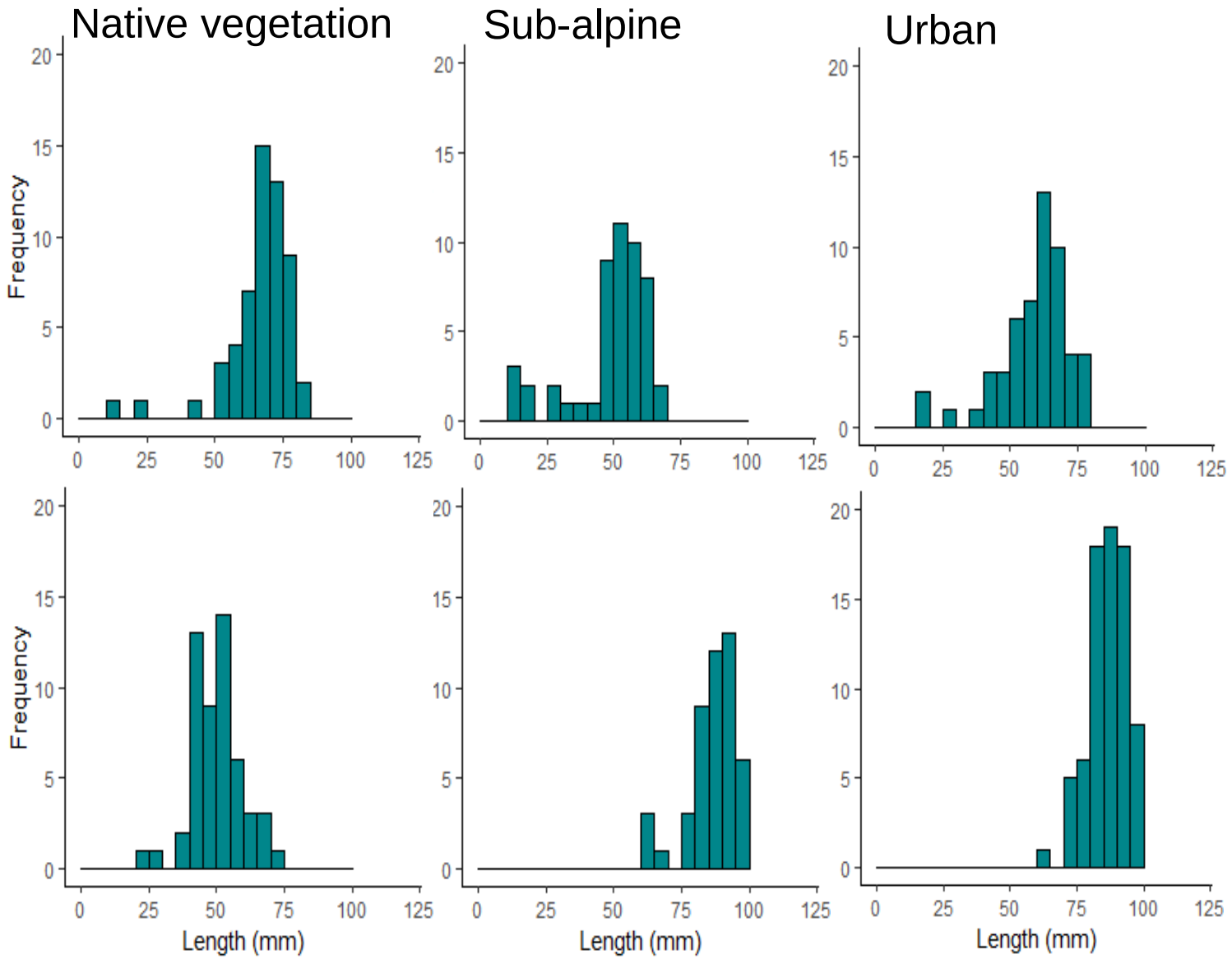
Density – quadrat sampling

Record/ measure individuals
(~50 per site)

Mark/recapture

- Tagging
- Seasonal sampling and monitoring

Populations dominated by ageing individuals

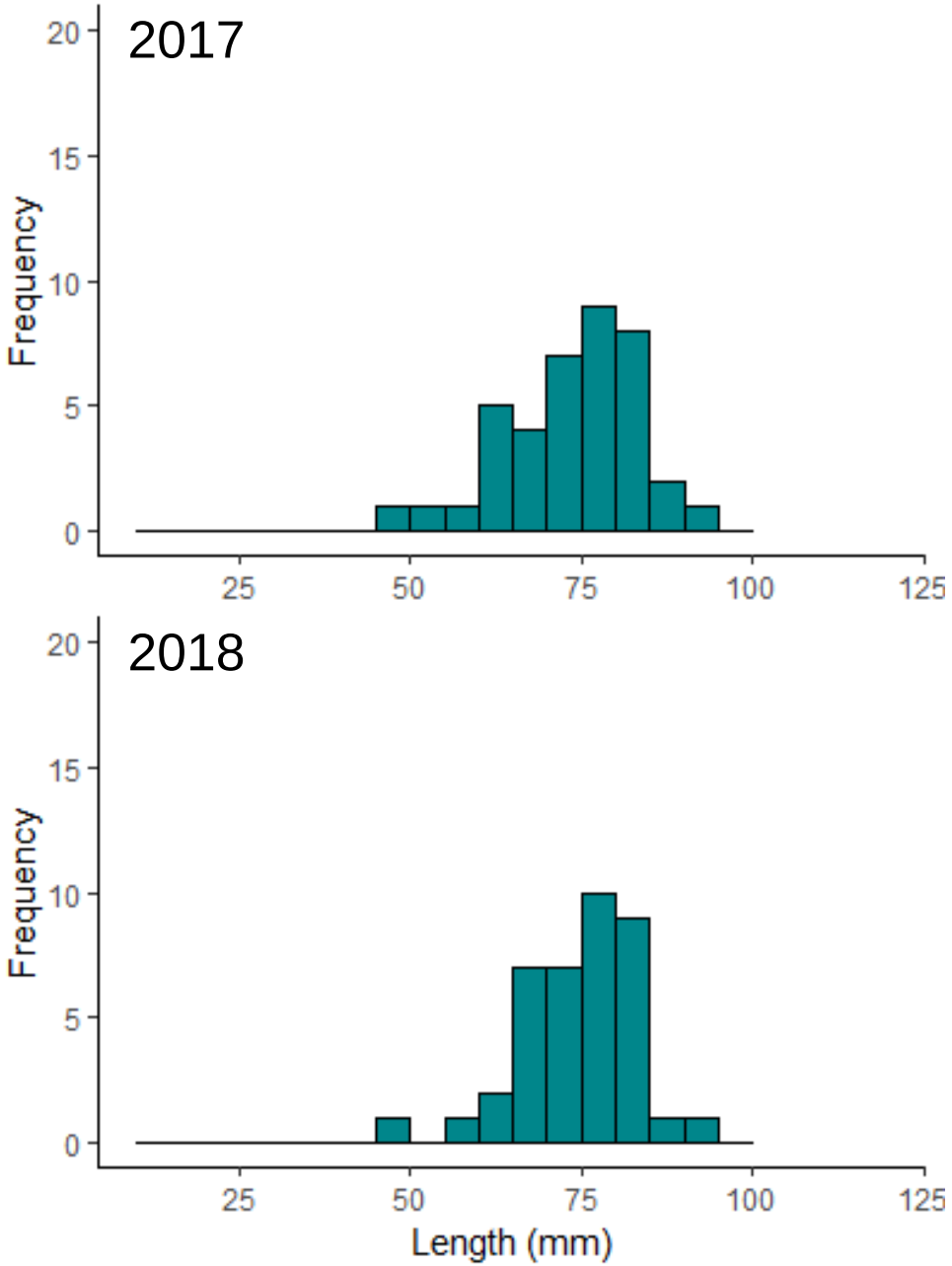


General decline and Juvenile paucity

- Pollution?
- Predation?
- Maintenance regimes?
- Land use?
- No mahinga kai (food gathering) sites

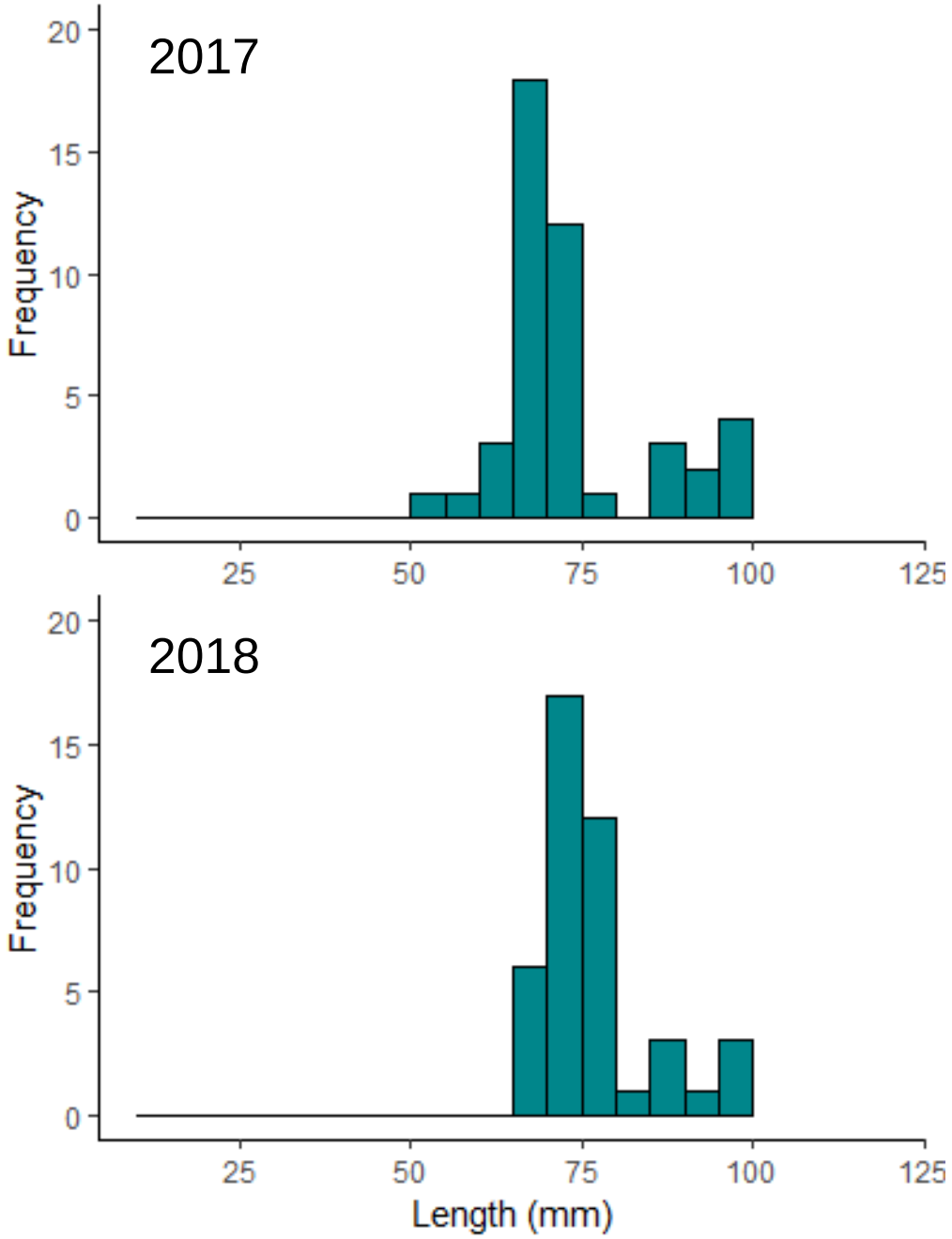
Rural population

Growth of tagged individuals
~ 70% recapture rate

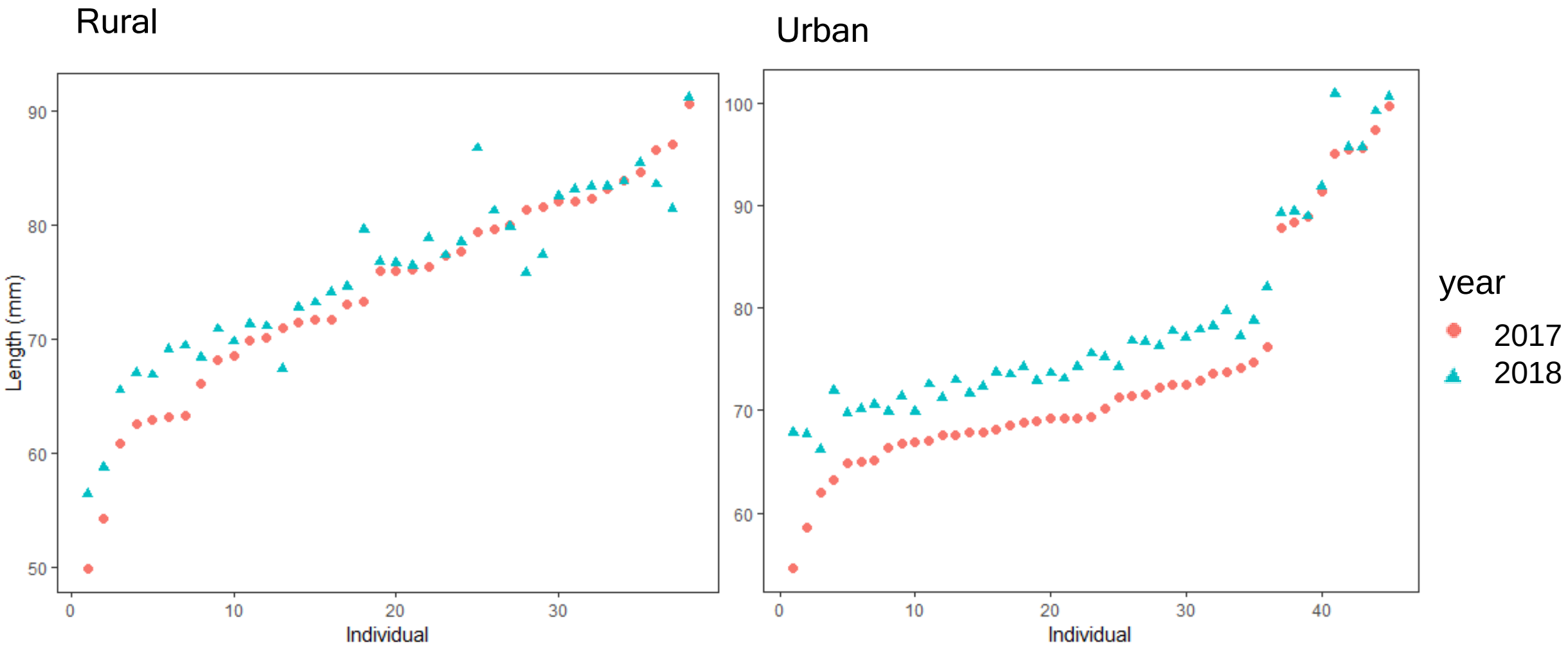


Urban population

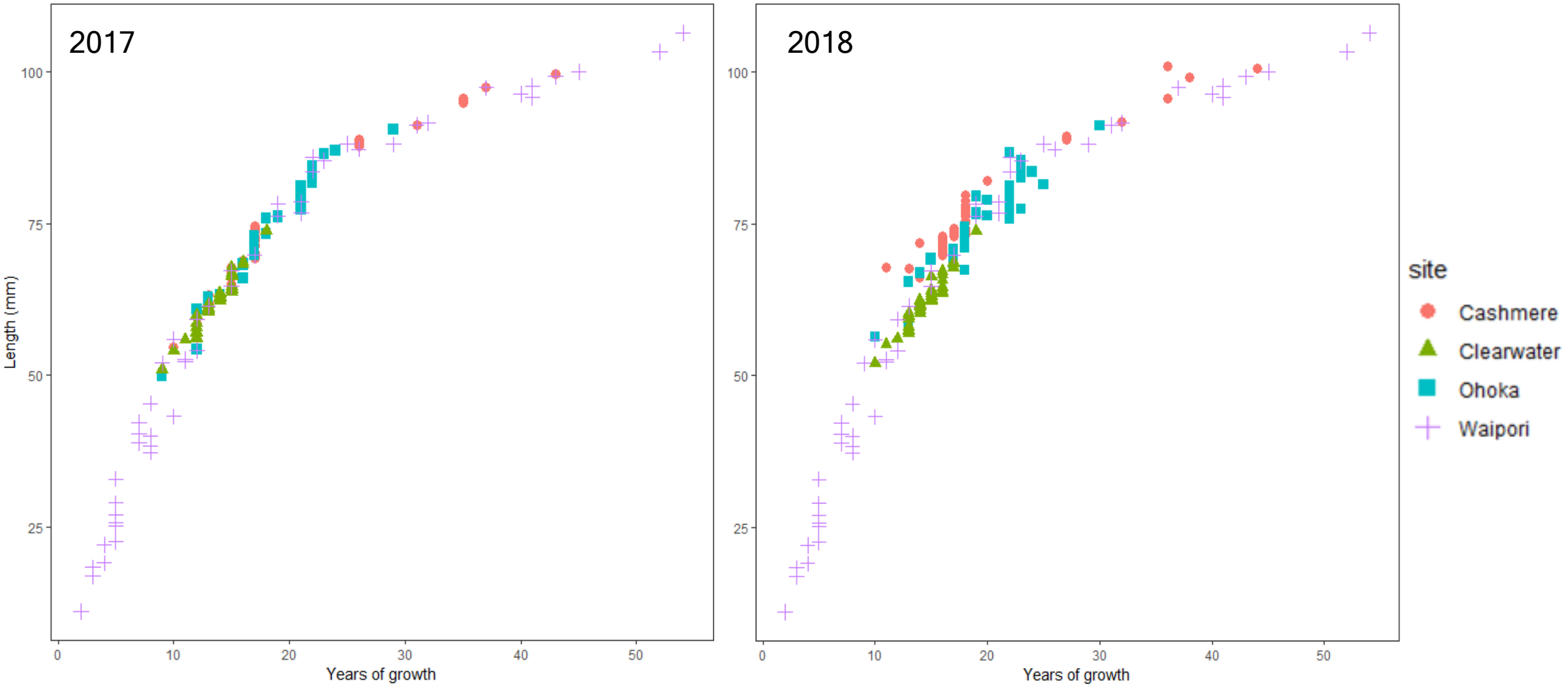
~ 30k South of rural site



Population growth rate 2017 - 2018



Growth rate variability – can length determine age?



Feeding experiments

Size class

Filtration/algae removal

Turbidity

Experiment set-up

3 block randomised design, n=30

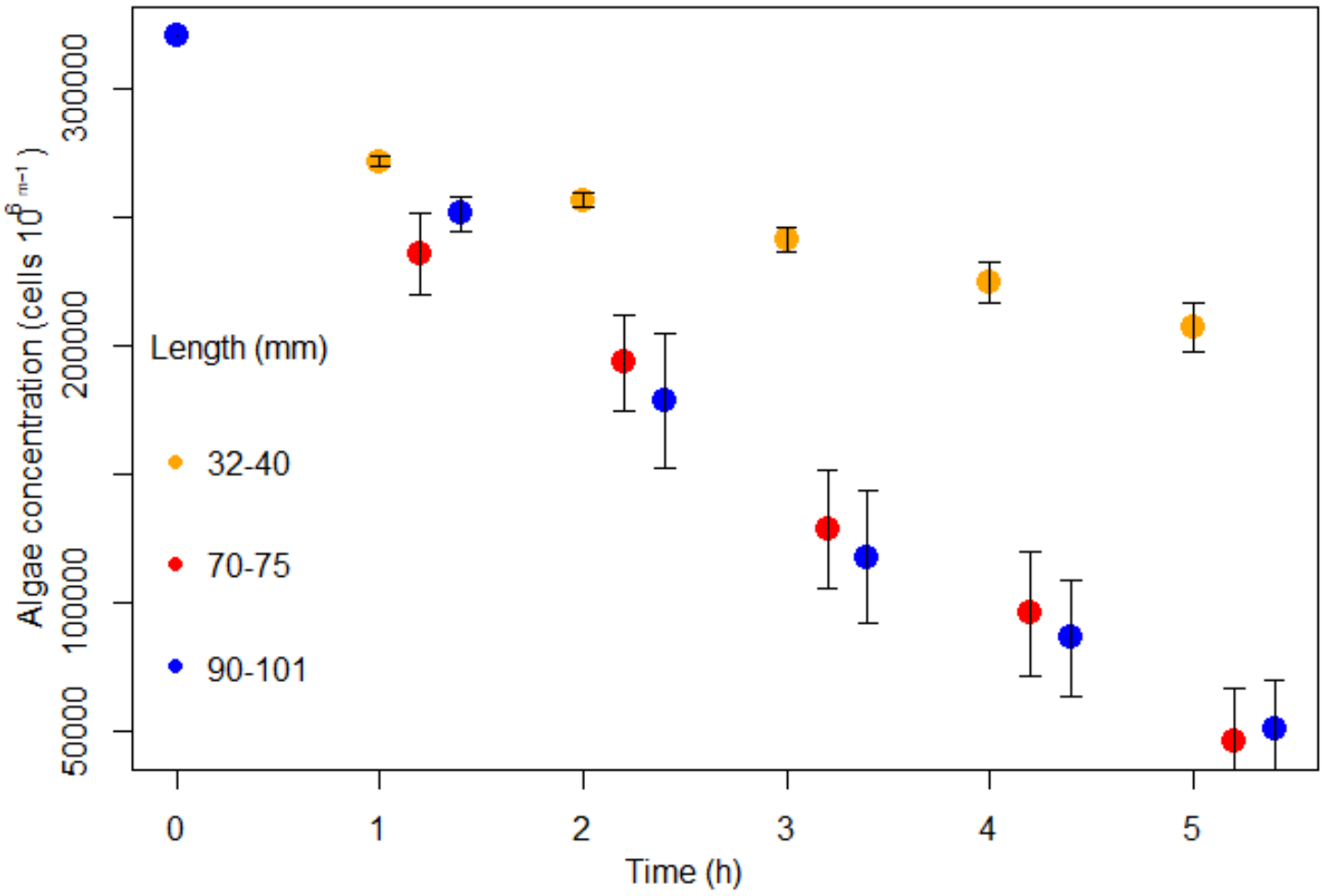
72h acclimatisation period

500ml feeding solution

5hr experiment

Observations taken every hour

Larger animals eat more



Size classes were determined from anterior posterior (A-P) shell length

Effects of turbidity on feeding

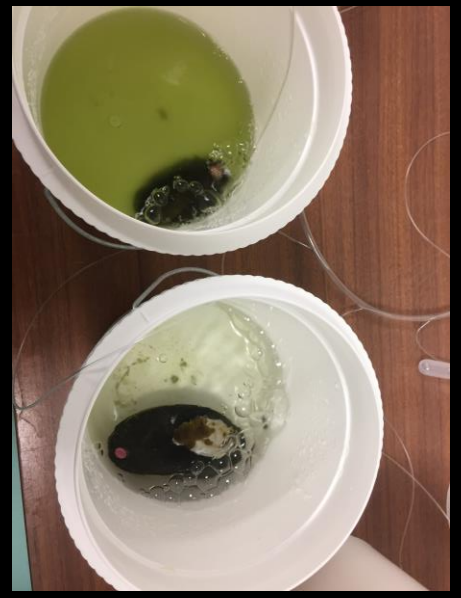
Two class sizes

60 – 73mm

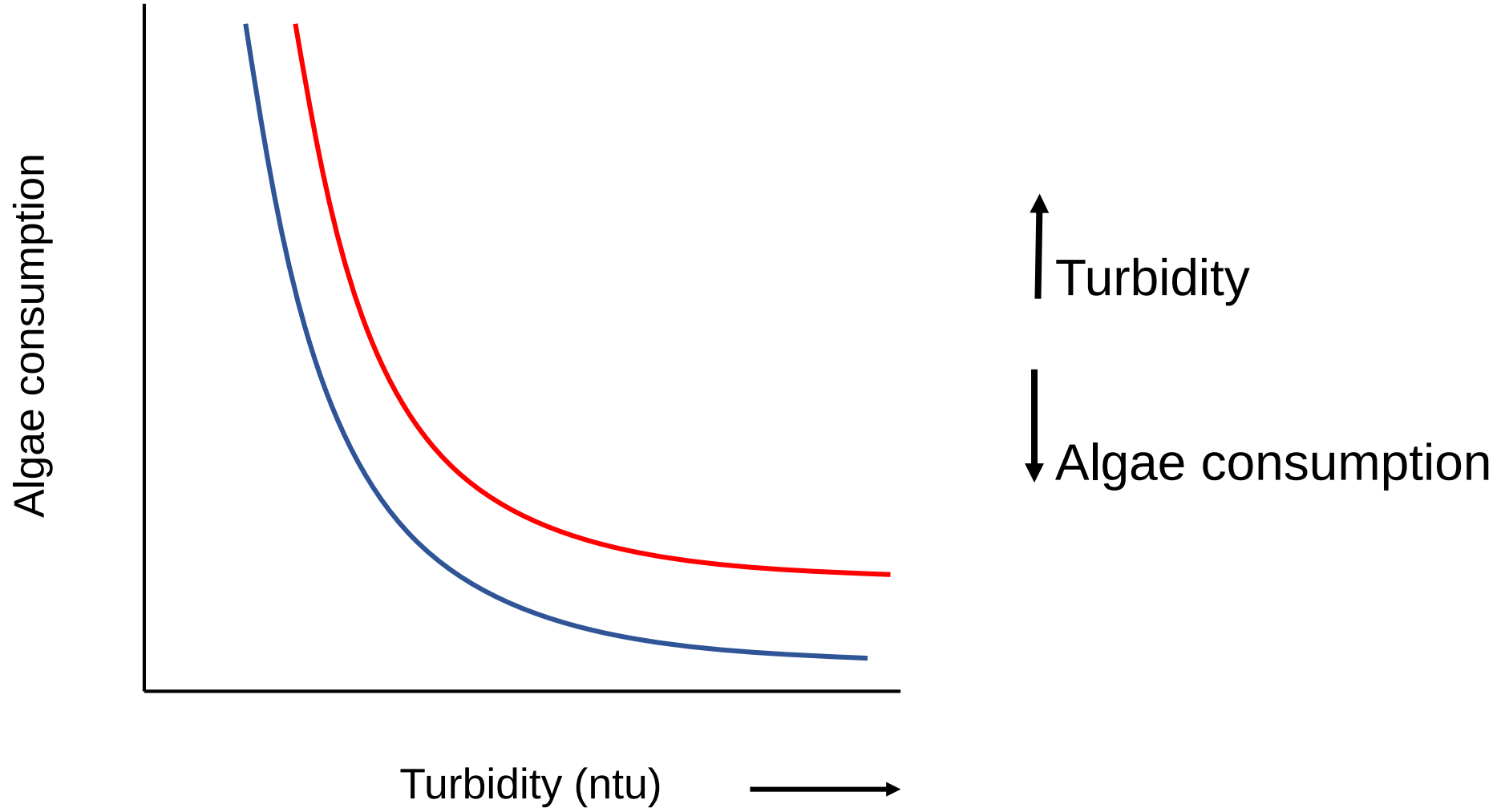
93 – 106mm

How effectively can mussels filter under turbidity

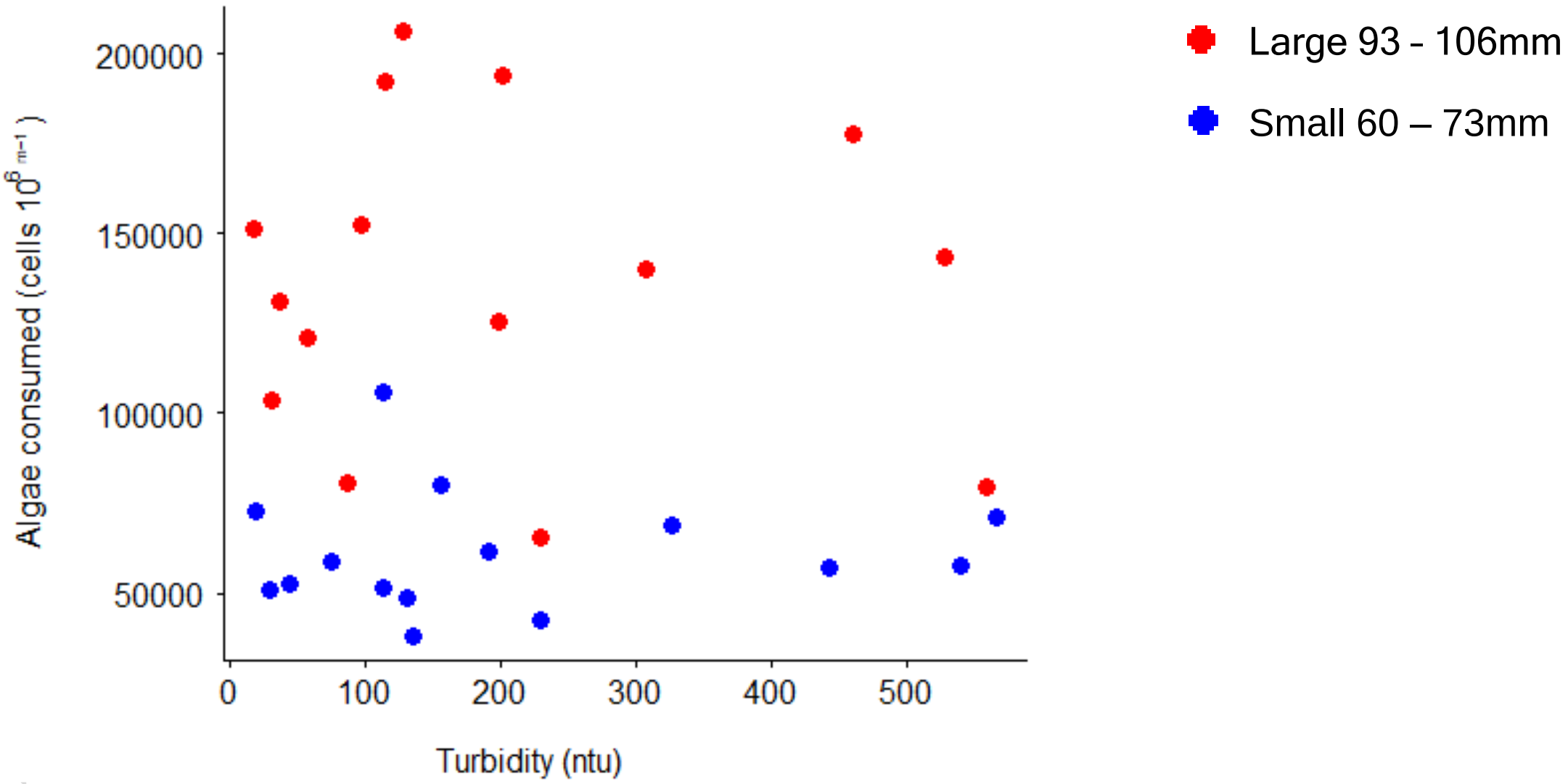
- 250mls feeding solution
- 250mls Halocyte solution (sediment mix)



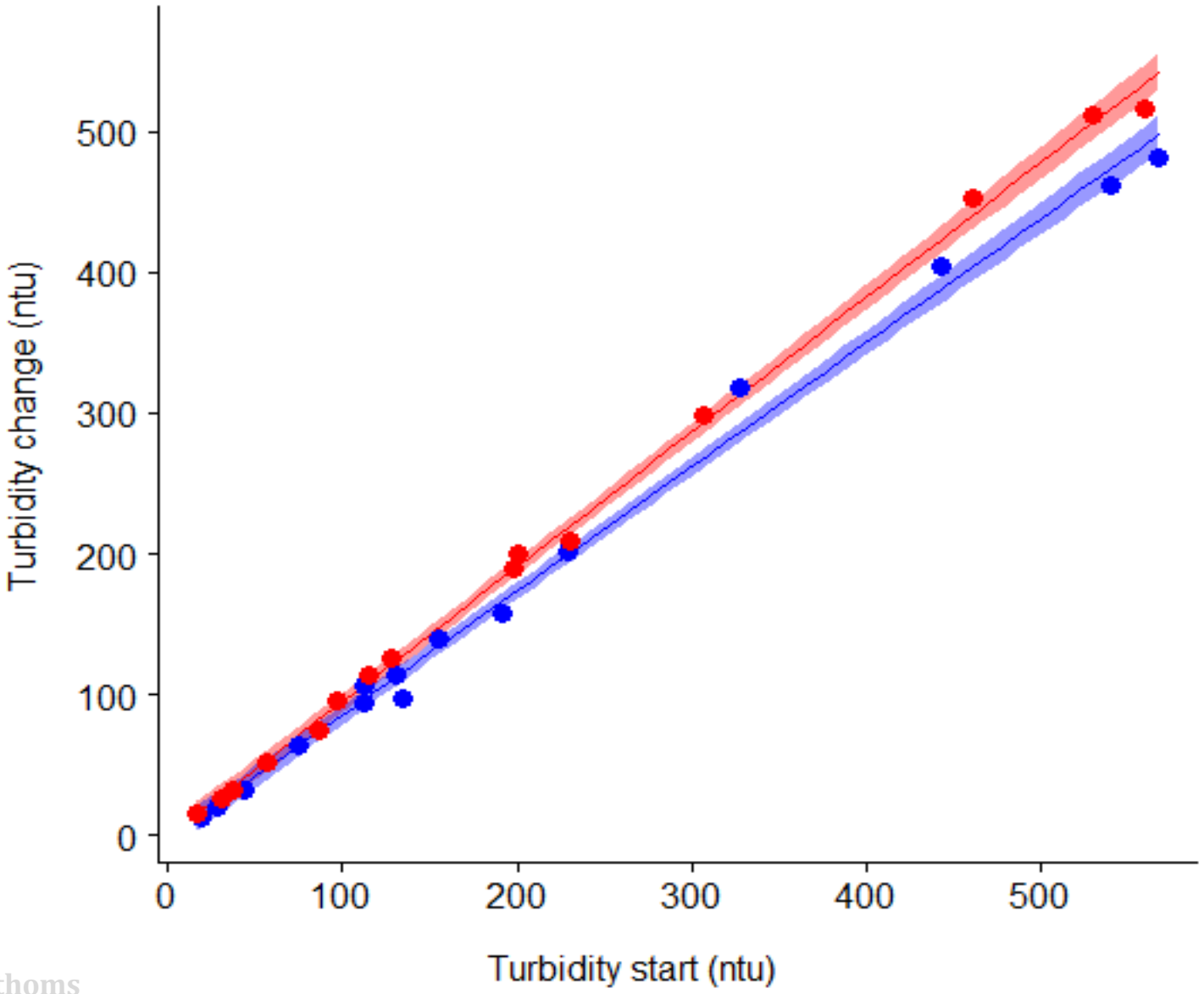
Affects of Turbidity on feeding – what we expected to see



Turbidity no effect on feeding



Animals facilitate settlement



Large 93 – 106mm

Small 60 – 73mm

Summary

Distribution declining

Population structure more larger animals

Growth rate can be site specific

Filtering efficiency size class

Sediment entrainment did not affect feeding

Can potentially facilitate sediment settlement

Acknowledgements

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Technicians: Jan McKenzie, Linda Morris, Hayley Devlin

Waterfall image: Sculls and Bones

Disclaimer

Absolutely NO specimens were consumed during the course of this study

……..However, tomorrow is another day……...

Nom, nom, nom

Kākahi

- Taonga species
- Bioengineers
  - Bio-turbators
  - Habitat enhancers
  - Filter feeders
- Ecosystem health indicator
  - Bio accumulation
  - Obligate parasitic stage

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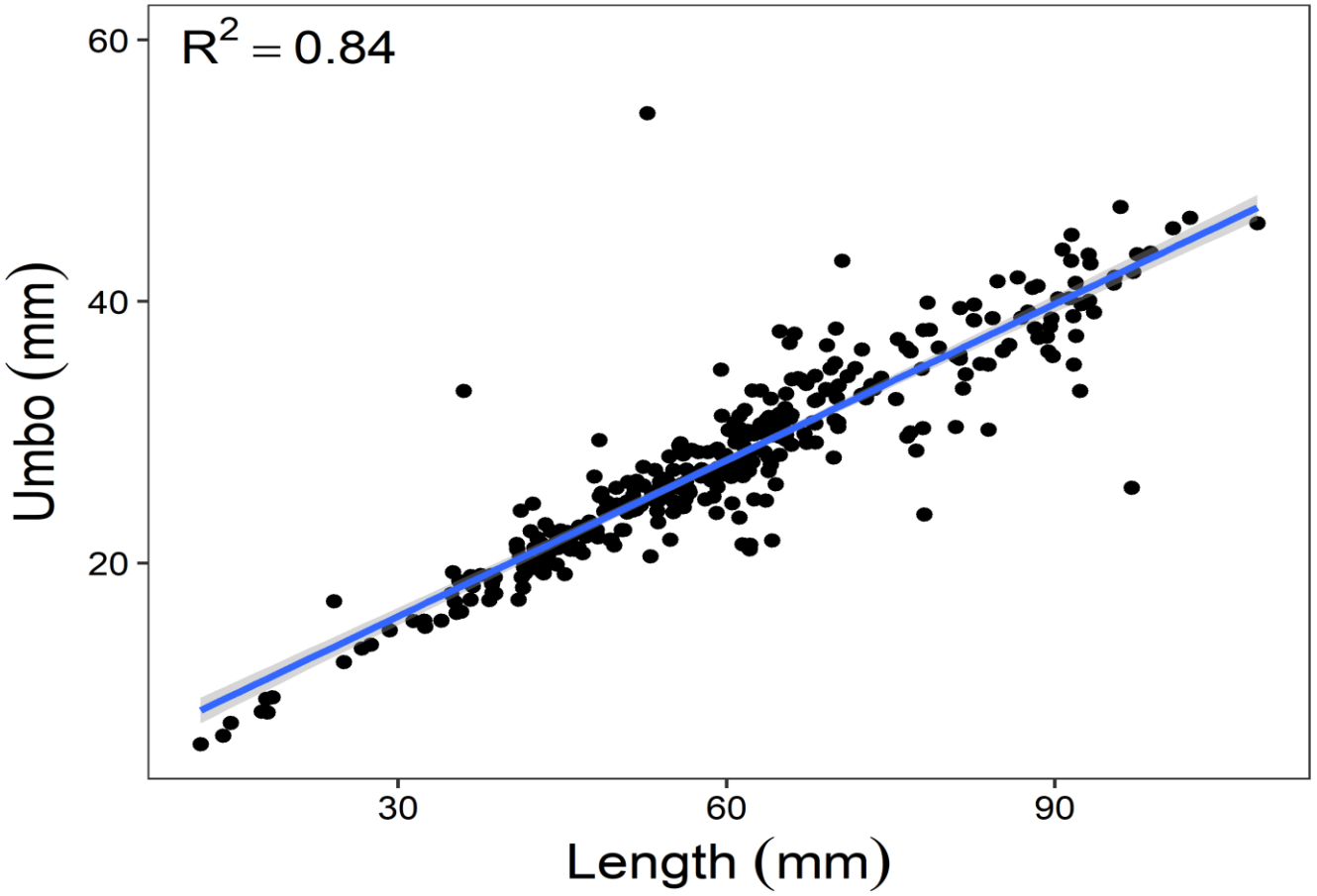
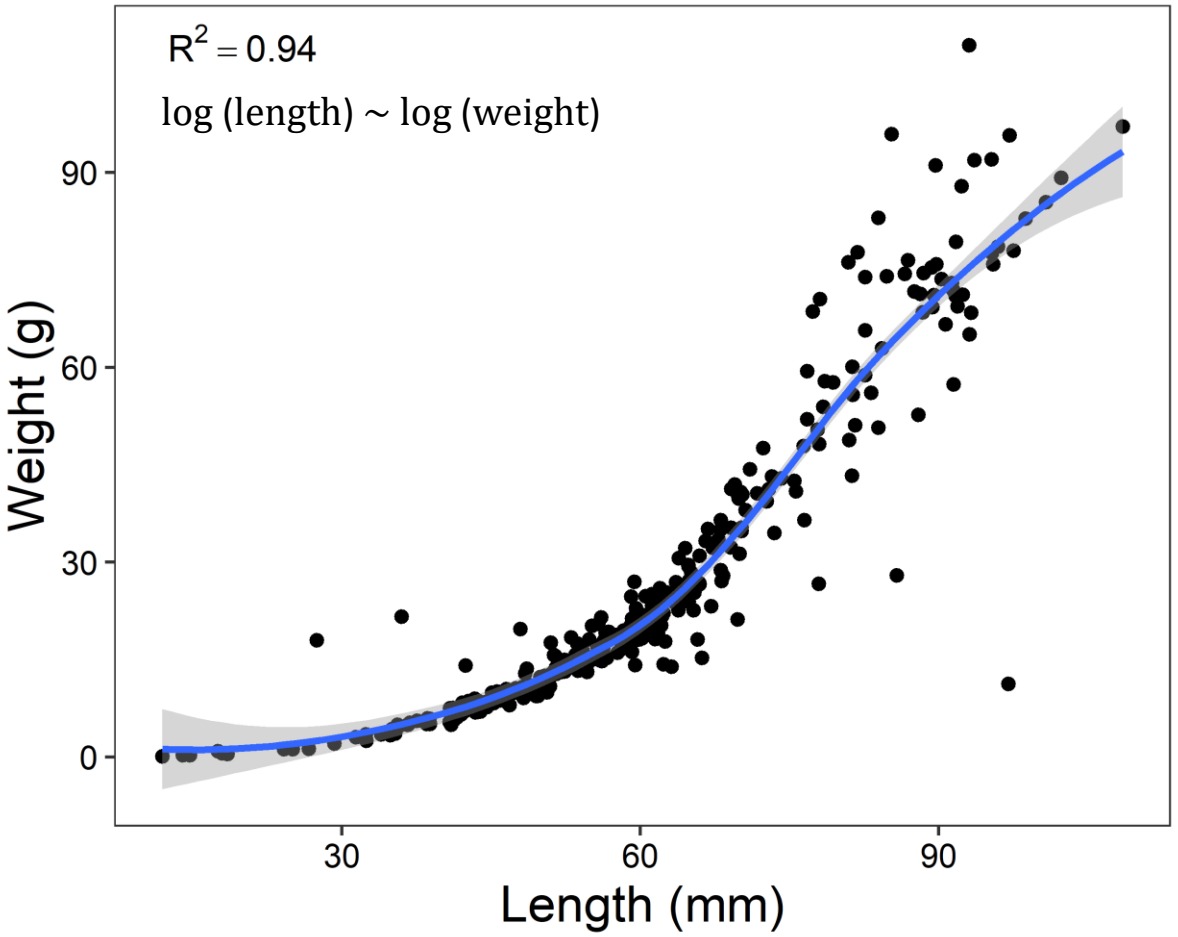
Length – Width correlation



Outliers

- Micro habitat dependent

Length – weight correlation



Correlation small, larger animals more variable

Could be indicative of

– Food availability

– Environment

New Zealand

- NZ ecology
- >170 species of birds 80% endemic
- Only one native terrestrial mammal (bats) and no freshwater mammals
- Native freshwater fishes and invertebrates are mostly endemic

Uniqueness of NZ waterways we have no native herbivorous fishes

No native algae eating fishes, all this is up to invertebrates

Generalists invertebrates

Carnivorous fishes

GRAPHICS OF OUR FOODWEBS

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issues in New Zealand

green”……

New Zealand

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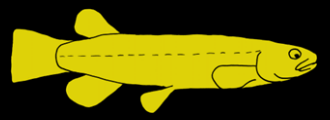

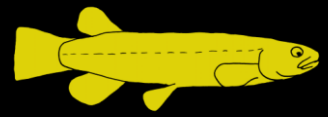

GRAPHICS OF OUR FOODWEBS

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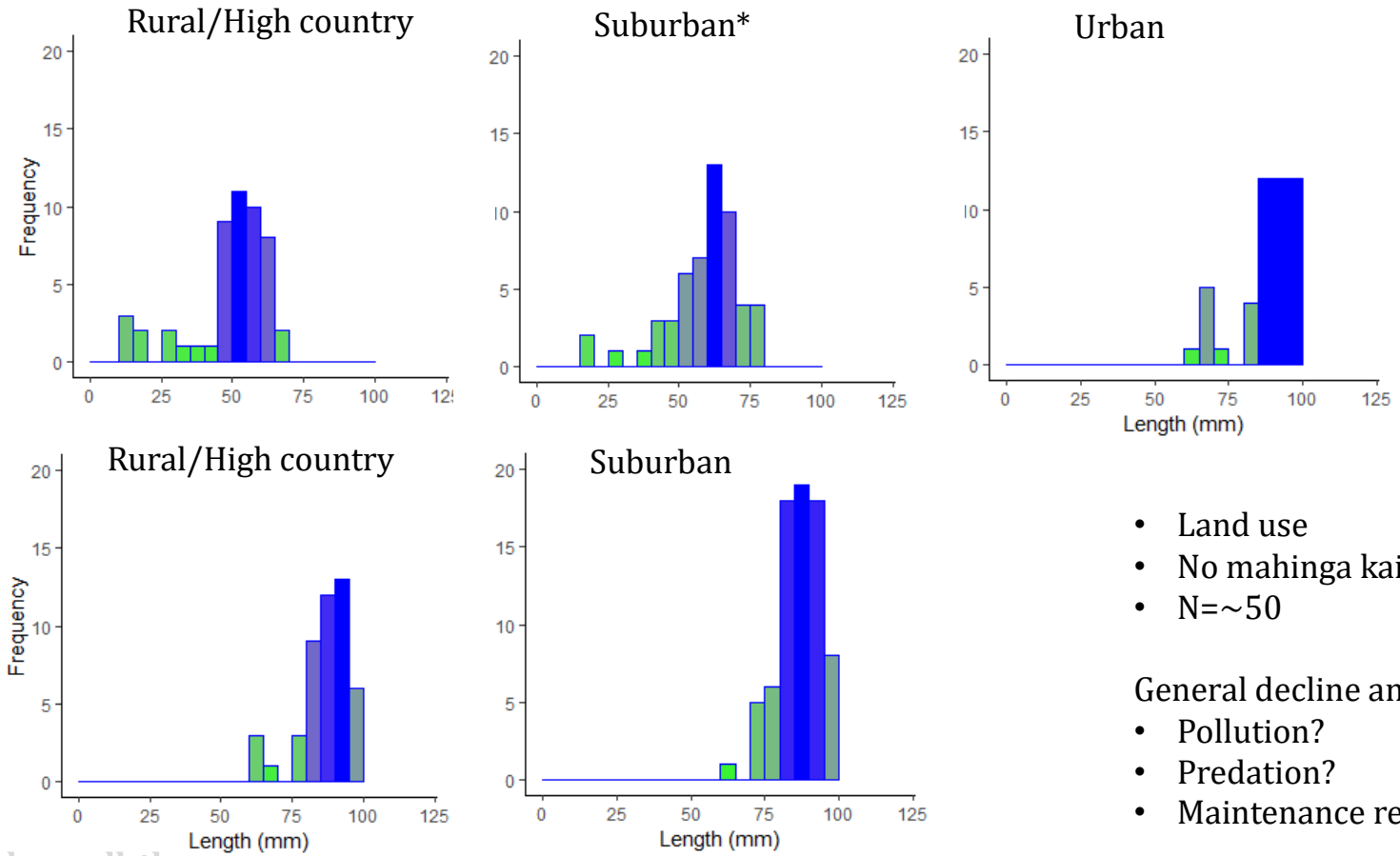
Result 2: Populations dominated by ageing individuals



- Land use
- No mahinga kai (food gathering) sites
- N=~50

General decline and Juvenile paucity

- Pollution?
- Predation?
- Maintenance regimes?

Kākahi

Freshwater mussels or kākahi (*Echyrydella* sp.) are highly-valued species by Māori indigenous peoples of Aotearoa New Zealand. Kākahi are ecologically important as filter feeders, ecosystem engineers and are recognised by Maōri as an important food resource. Functionally, this species removes algae and particulate matter including potentially harmful bacteria while also creating habitats for other species. For example, they assist with sediment transport through bioturbation and their living and spent shells serve as habitat for other invertebrates. Unfortunately, the species is now classified as “in decline” and there are grave concerns for their persistence. There are knowledge gaps about feeding behaviours and preferences at the individual, population and community levels of organisation which could be essential to informing translocation of individuals and restoration of their habitats. Here we present preliminary research that examines *E. menziesi* in streams and river ecosystems in the Canterbury and West coast regions of the New Zealand South Island. First, field surveys were conducted based on historic knowledge of their distributions. Sites ranged from highly-modified agricultural drains in Canterbury to forested, less human impacted regions of the West Coast. Next, feeding trials were conducted to assess rates across size classes and turbidity levels. Findings show strong relationships between size classes and filtering effeciency. Finally, freshwater mussel conservation is a global issue thus we conclude with hypotheses to inform future translocations and restoration of their stream habitats and seek to connect our understanding with systems across Europe and around the world.

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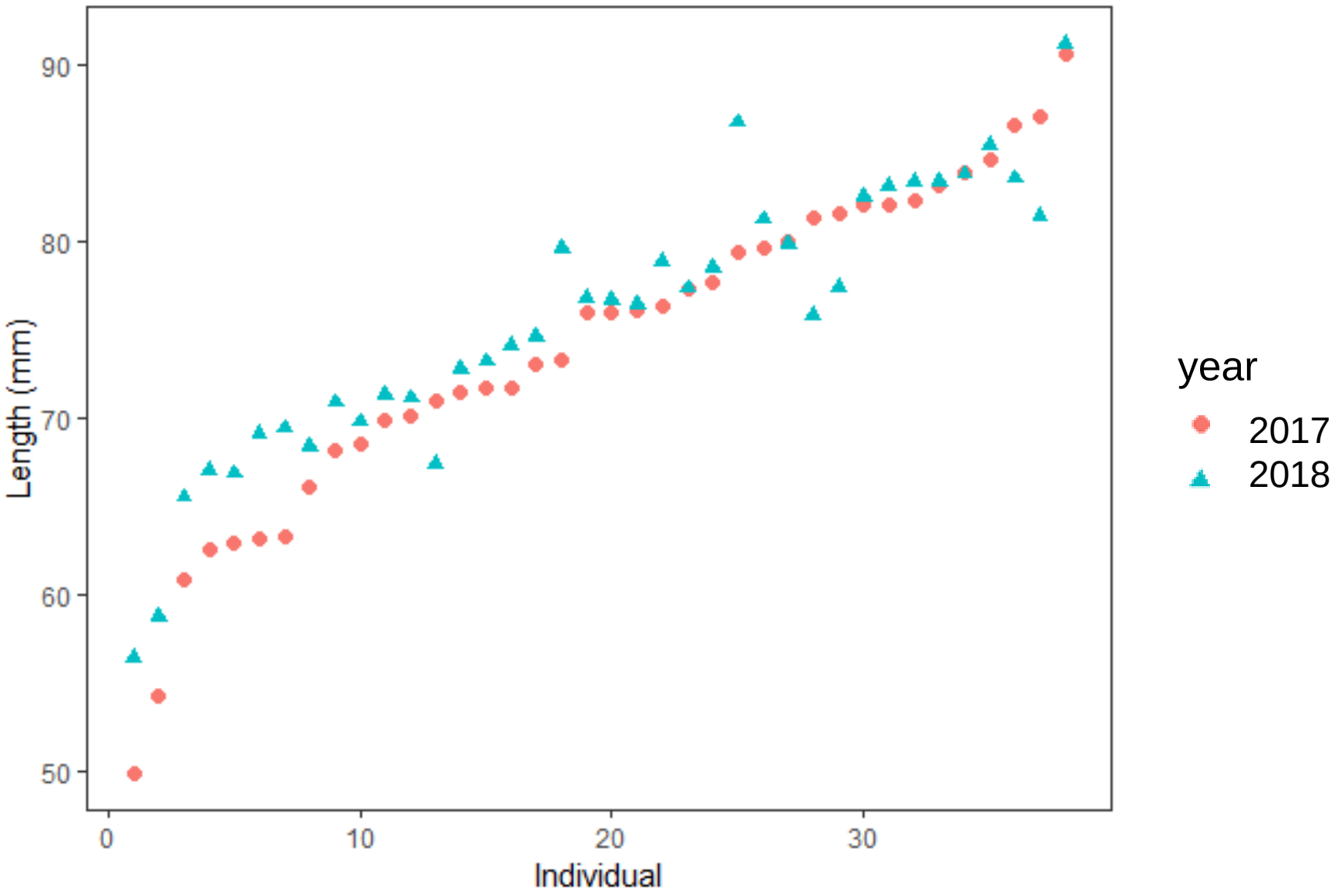
Rural population growth rate 2017 - 2018



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Urban population growth rate 2017 - 2018