

Influence of flow and land cover on aquatic communities of the Waimakariri catchment

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Background: Waimakariri catchment



Large, runoff, snowmelt and glacial-fed braided river with diverse tributaries

Home to native eel, bully, and *Galaxias* species, non-native trout and salmon



Headwaters in native bush, alpine, tussock, and scrub lands

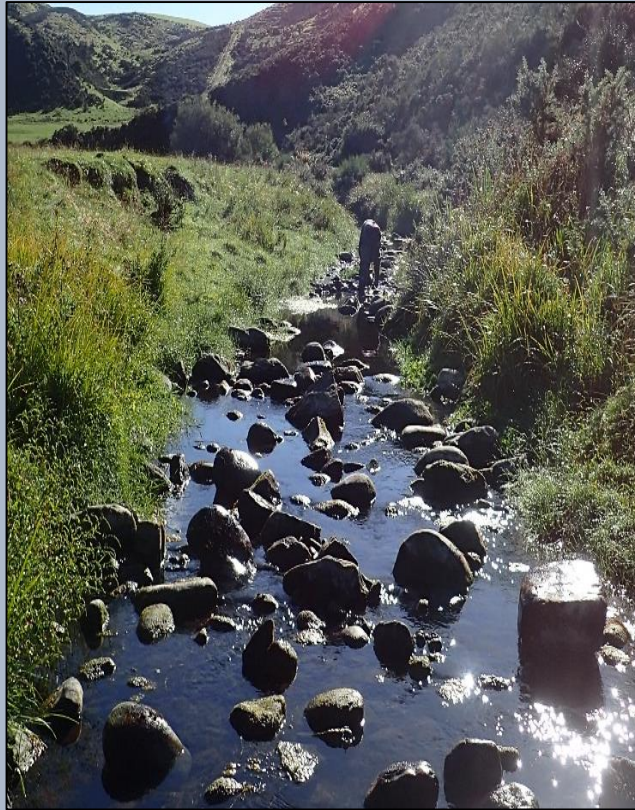
Background: Braided rivers



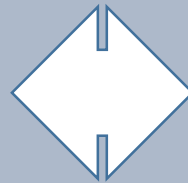
Present worldwide, beneficial for gravel and soil transport and deposition, resetting succession, flushing of pollutants

Braiding caused by combination of flooding, flow regime, substrate type, topography

Flood-proneness and riparian bare ground cover

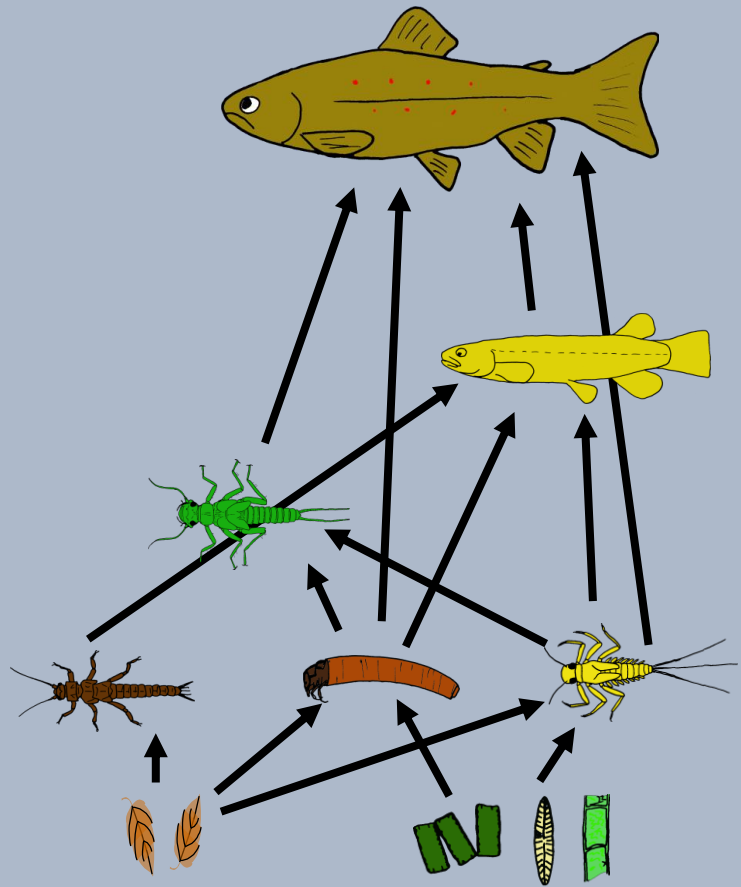


Stable/low % bare ground
“Benign”



Disturbed/high % bare ground
“Harsh”

Background: Food webs and fish body size



Stable isotope food web structure
useful for characterization, monitoring

Fish body size and mass-abundance
indicative of stream productivity, food
availability, etc.

Isotope and body size modulated by
habitat characteristics, biota, human
modifications

Food chain length

Nitrogen isotope ratio

Trophic position

Low

	2



Food chain length

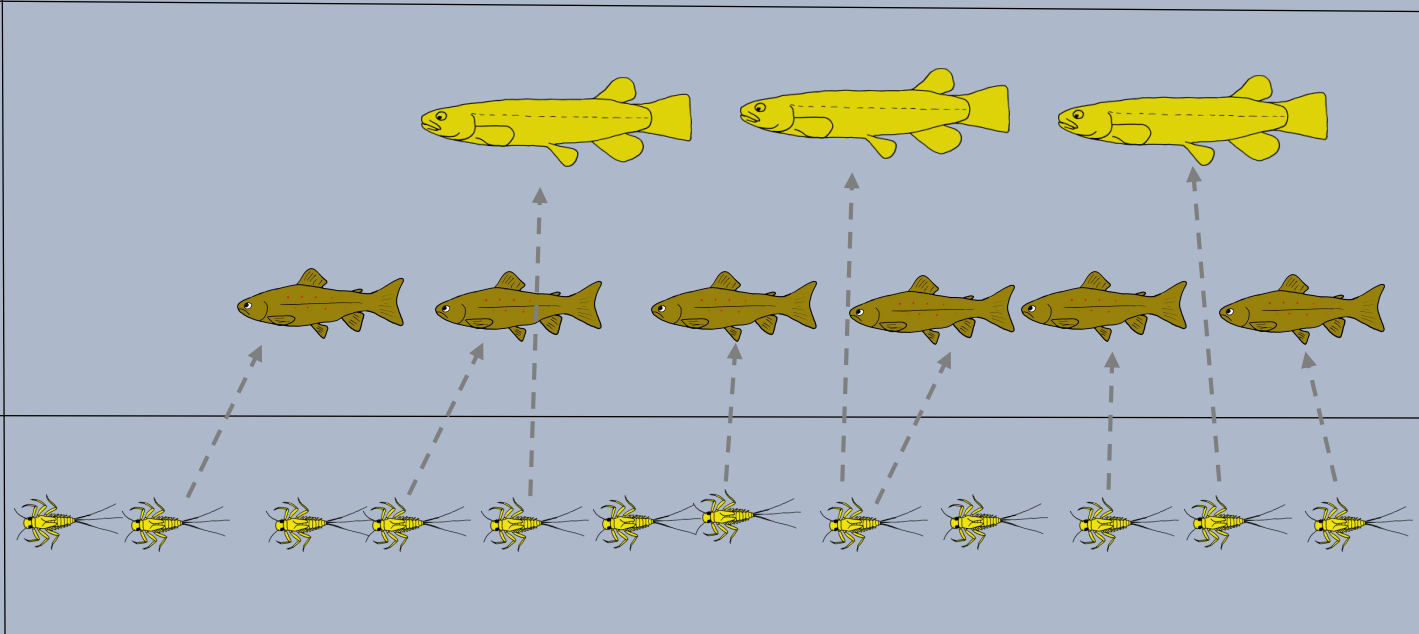
Nitrogen
isotope
ratio

Trophic position

Low-medium

Low

2



Food chain length

Nitrogen isotope ratio

Trophic position

Medium

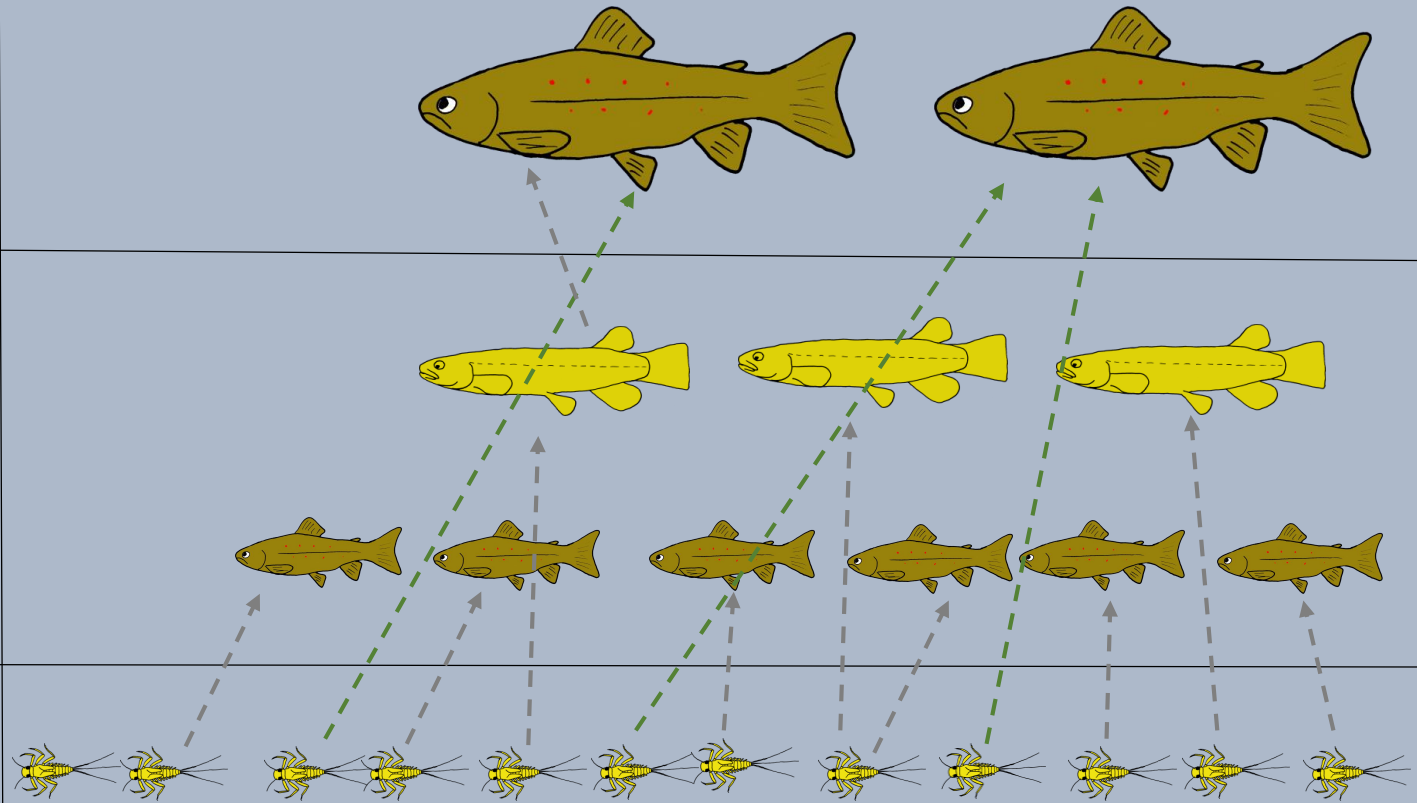
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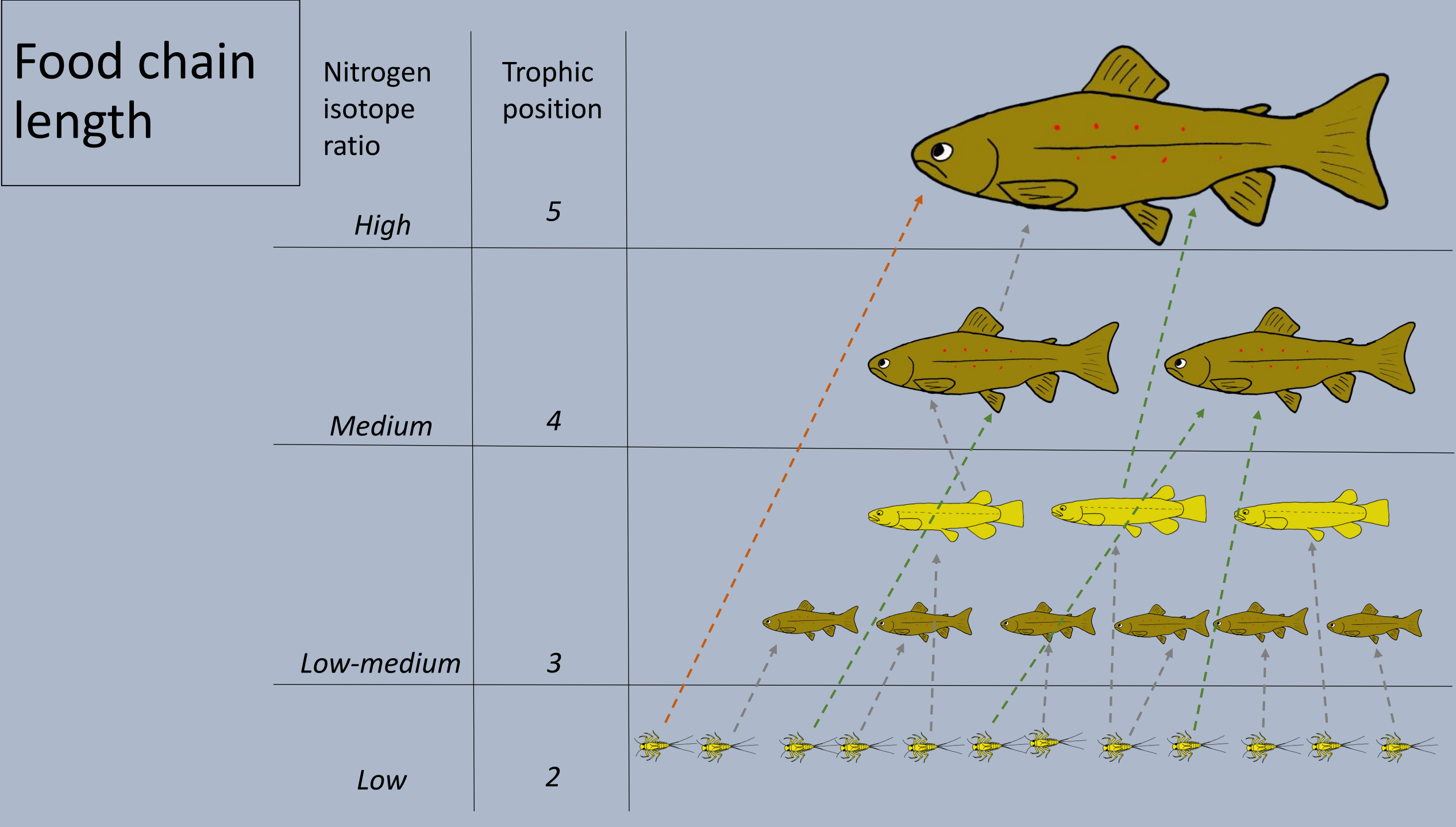
Low-medium

3

Low

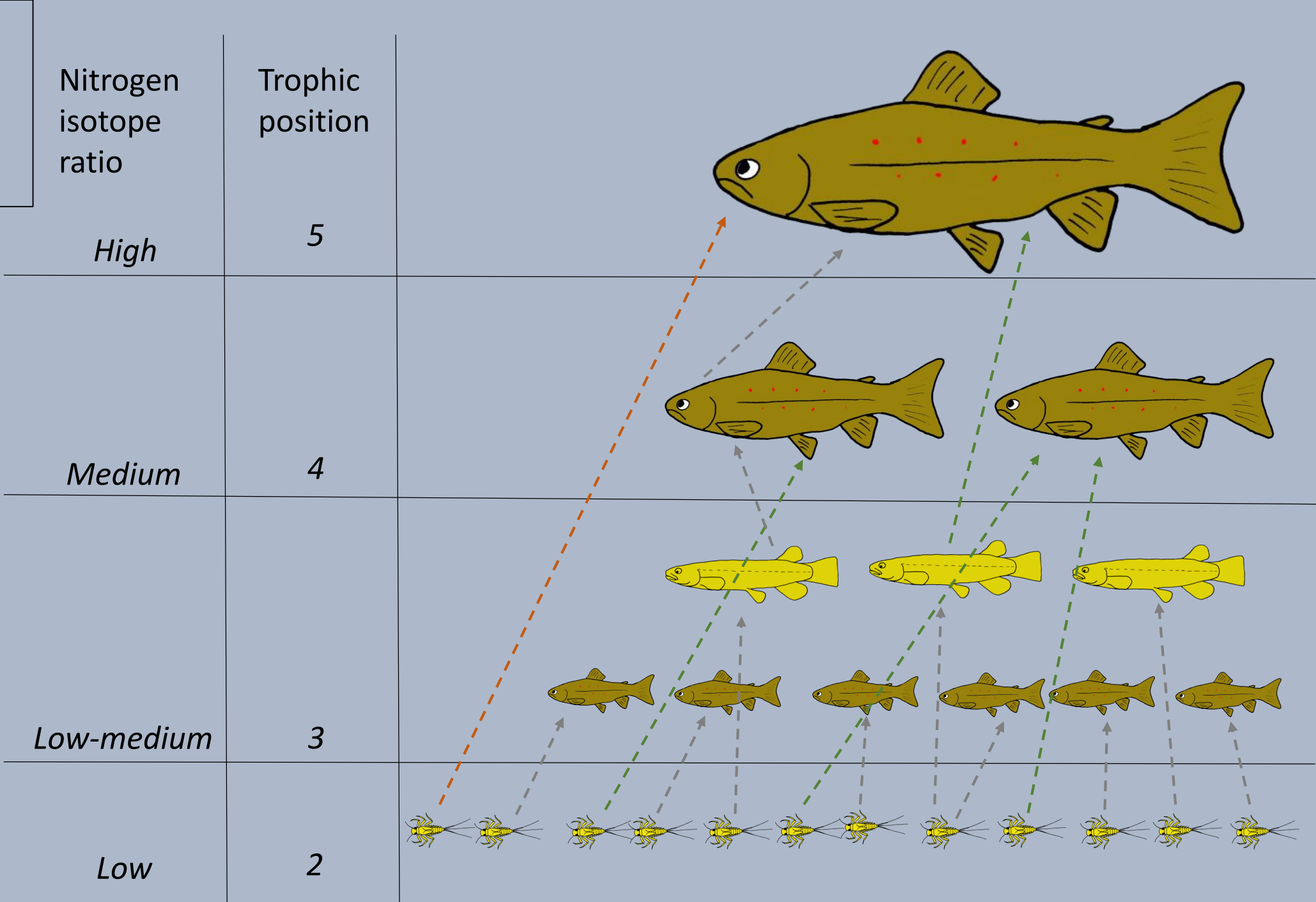
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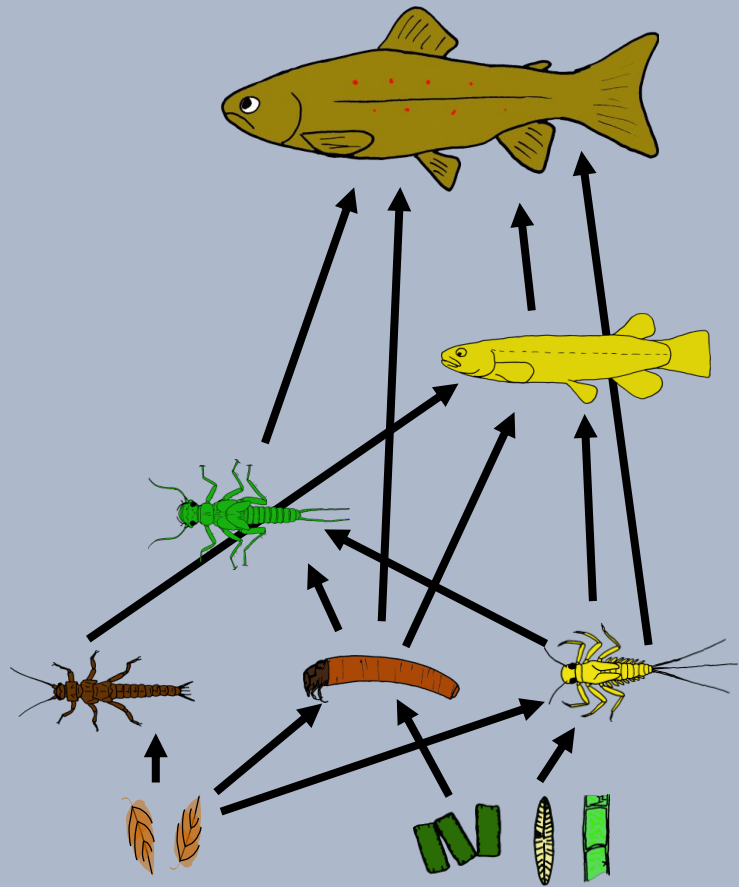


Food chain length

Food-chain length



Background: Food webs and fish body size

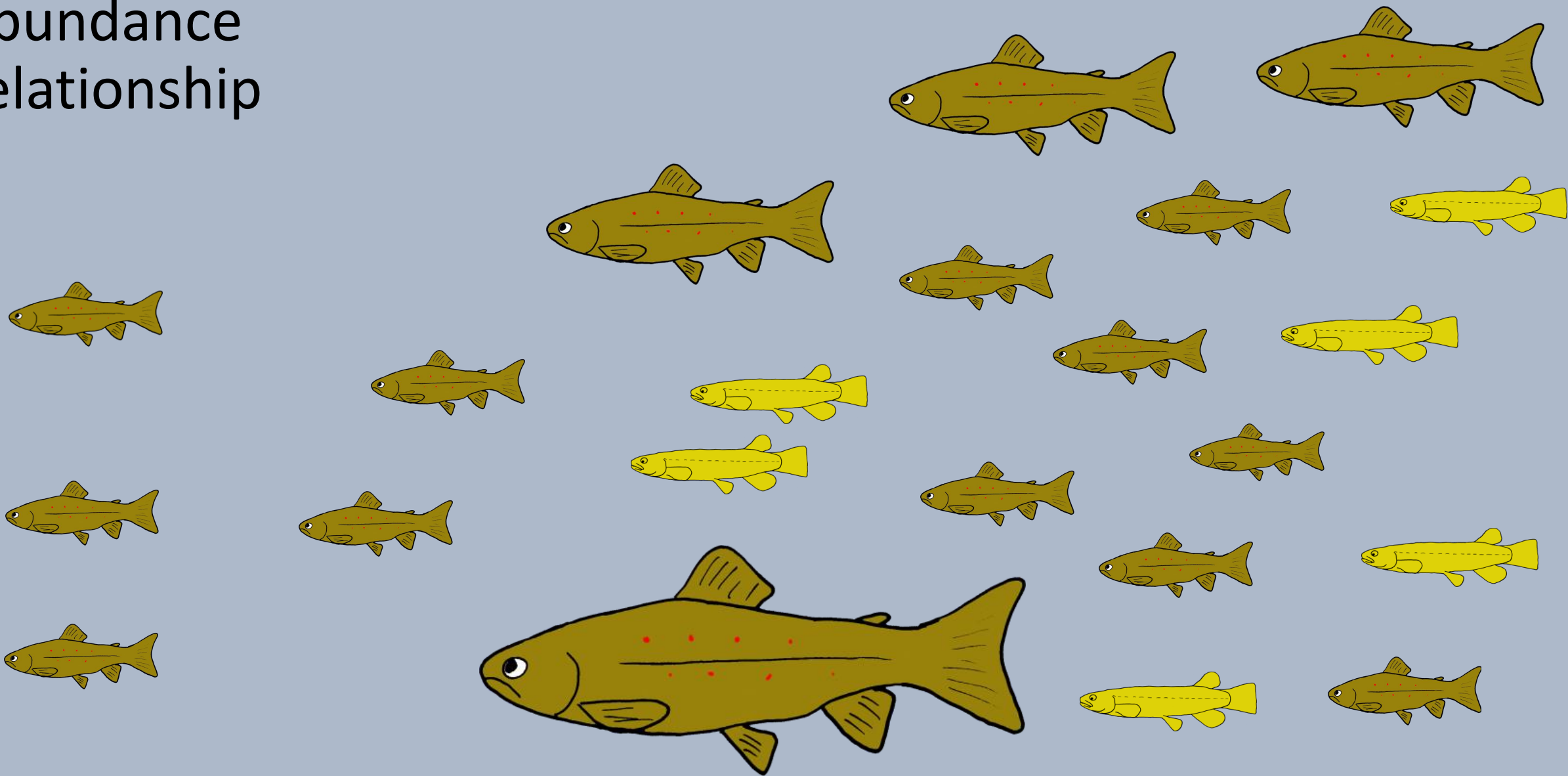


Stable isotope food web structure
useful for characterization, monitoring

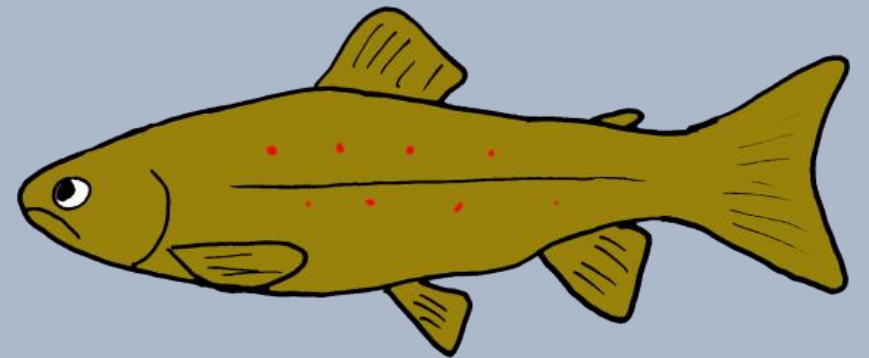
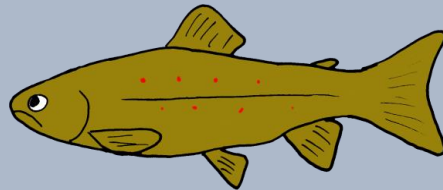
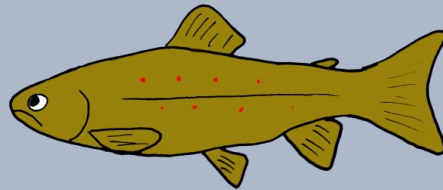
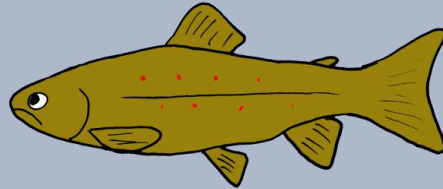
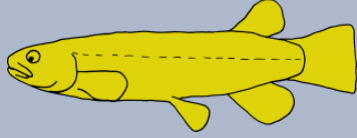
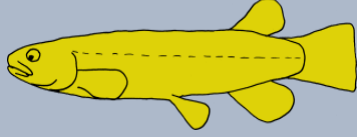
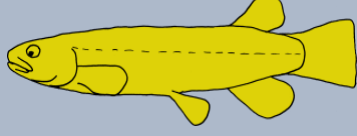
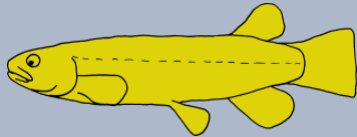
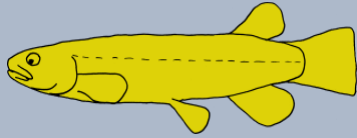
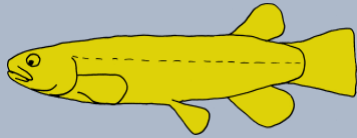
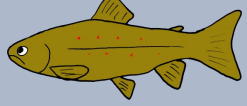
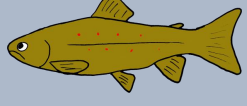
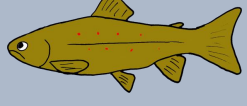
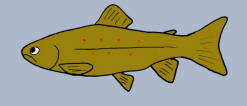
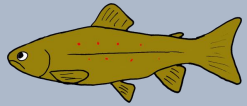
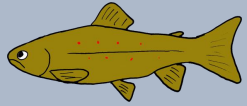
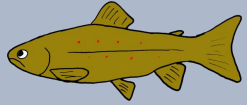
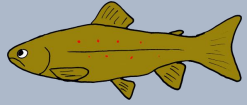
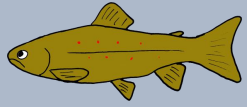
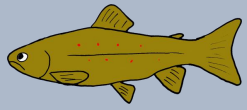
Fish body size and mass-abundance
indicative of stream productivity, food
availability, etc.

Isotope and body size modulated by
habitat characteristics, biota, human
modifications

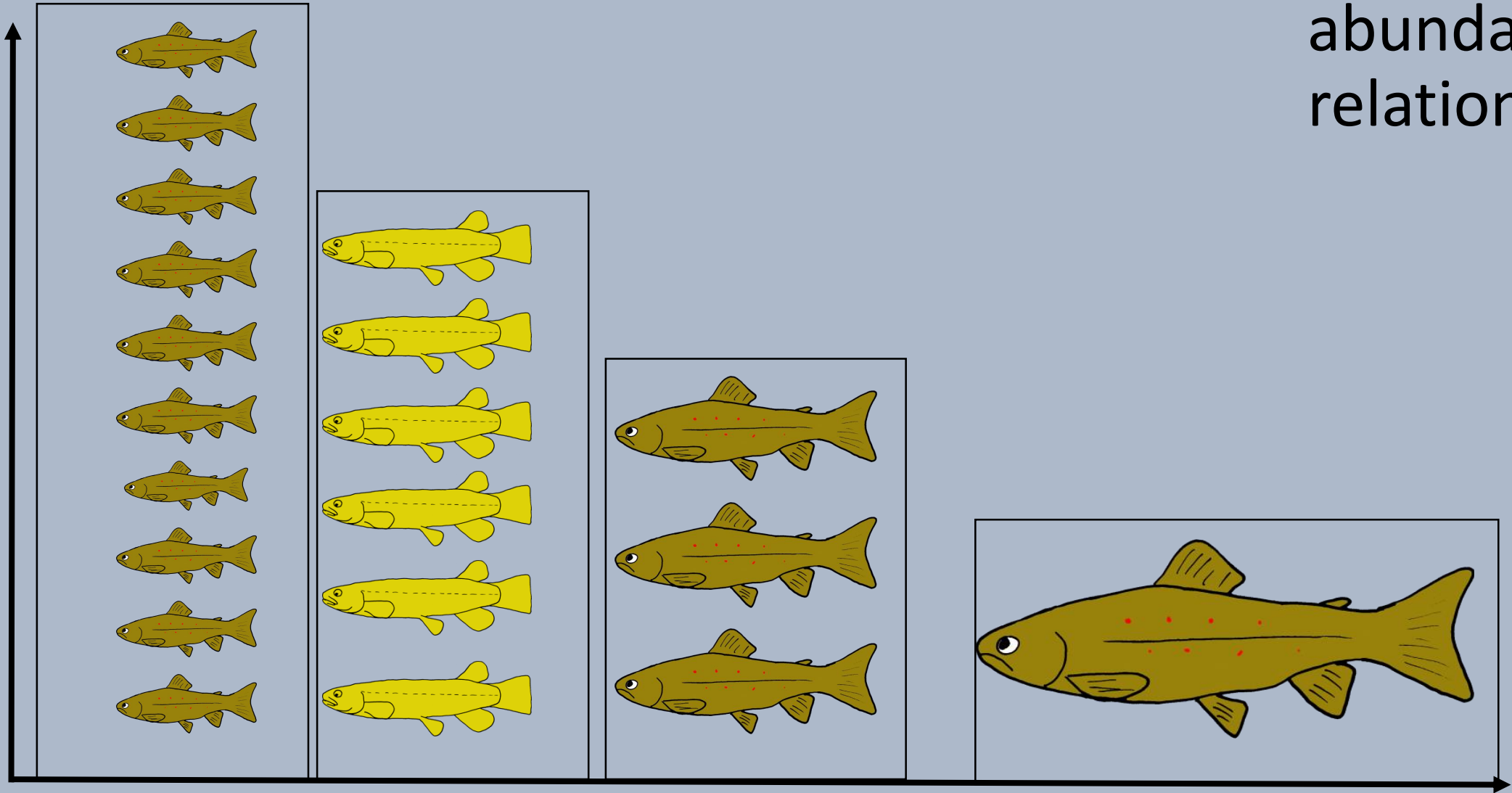
Mass-
abundance
relationship



Mass- abundance relationship



Fish abundance

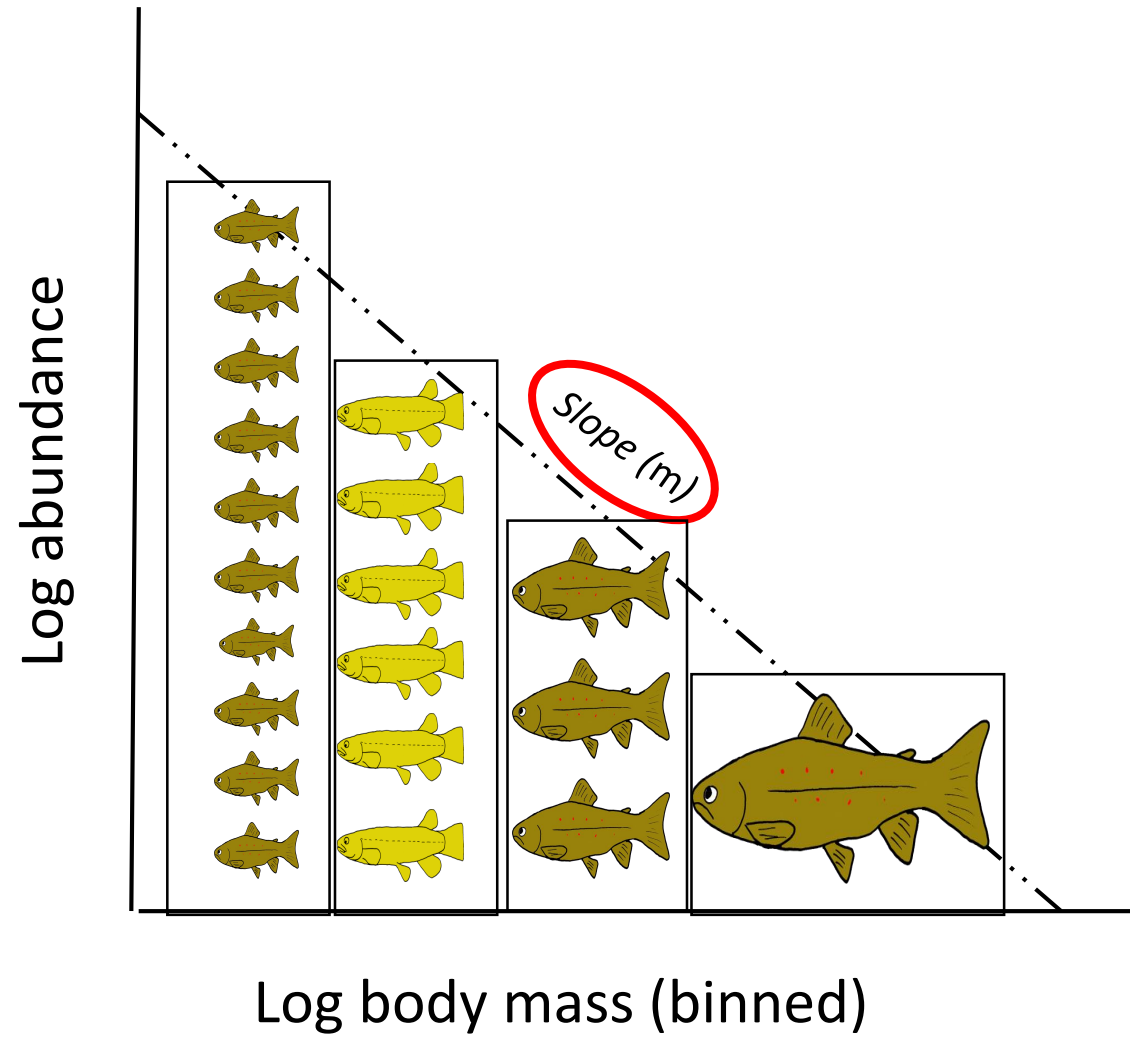


Mass-
abundance
relationship

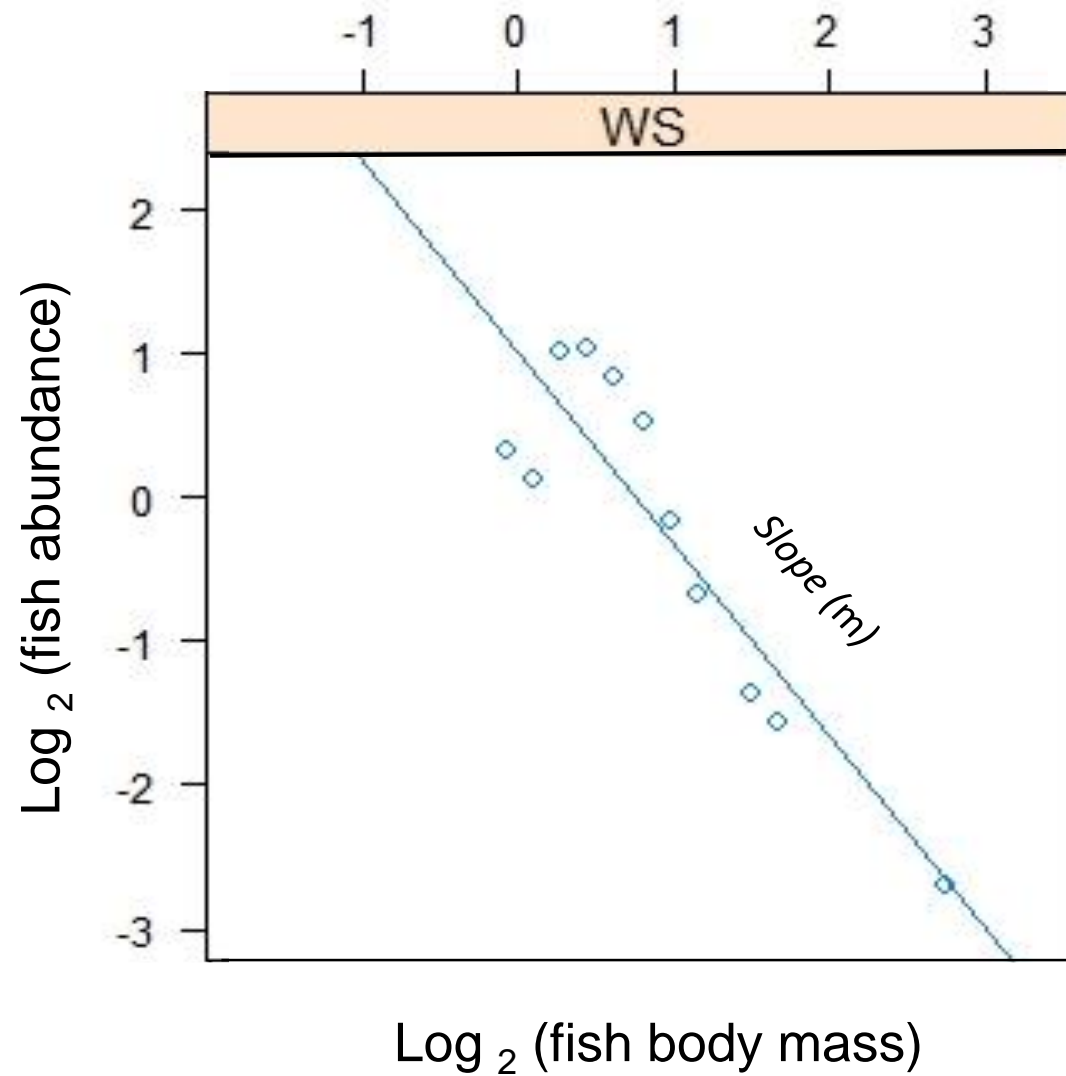
Fish body mass

Mass-abundance relationship

Warburton (2015)



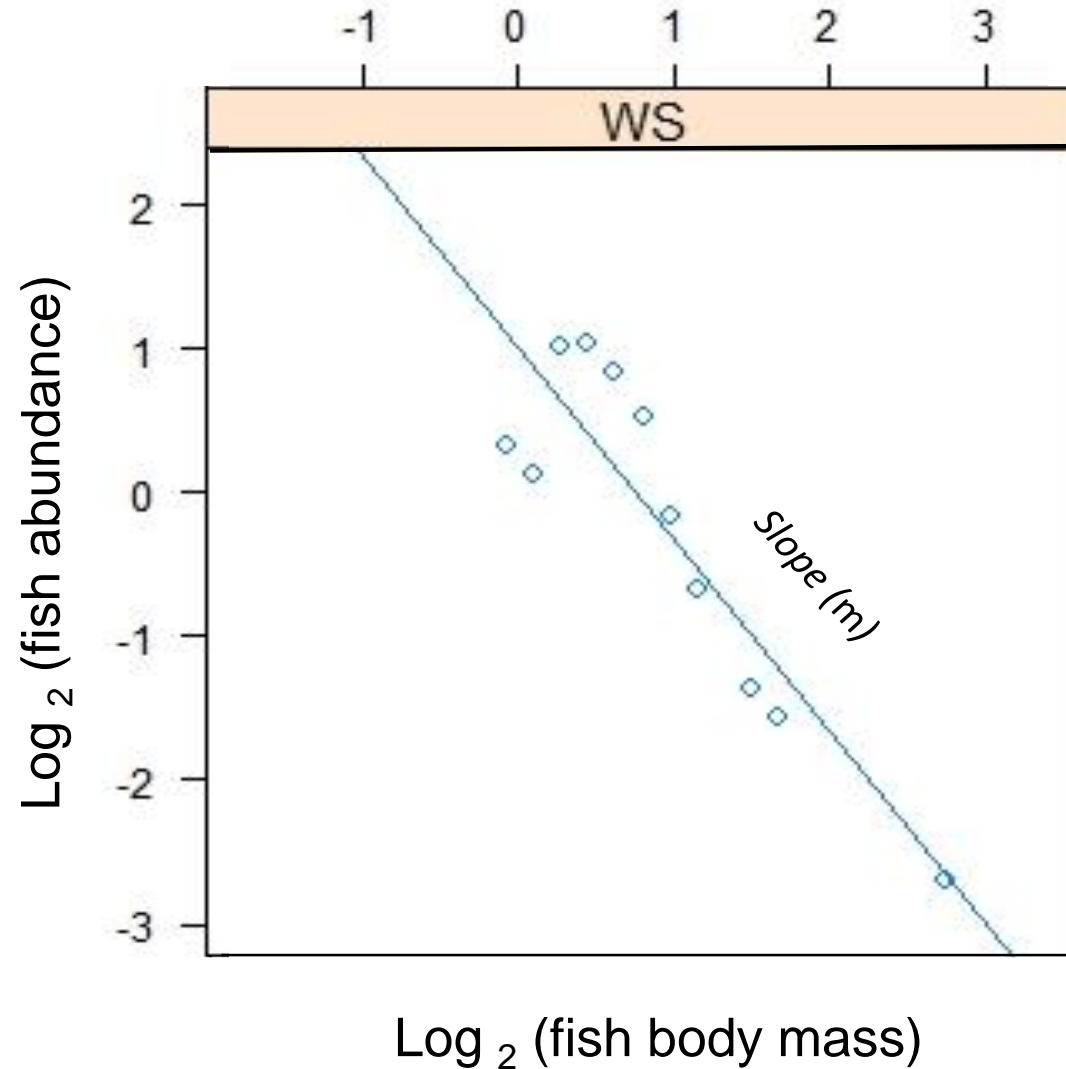
Results



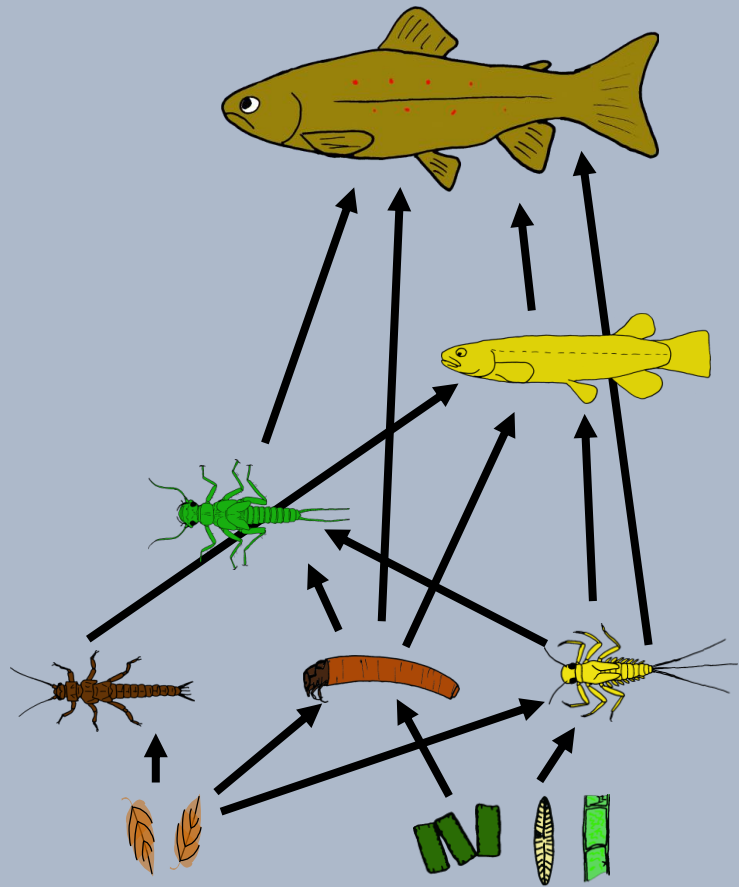
Results

Also assessing:

- Maximum body size
- Size range
- Total biomass



Background: Food webs and fish body size



Stable isotope food web structure
useful for characterization, monitoring

Fish body size and mass-abundance
indicative of stream productivity, food
availability, etc.

Isotope and body size modulated by
habitat characteristics, biota, land
cover?

Objectives

Evaluate effects of flood-proneness and flow (and associated braiding) on Waimakariri catchment fish assemblages

Identify the influence of land cover type on aquatic communities

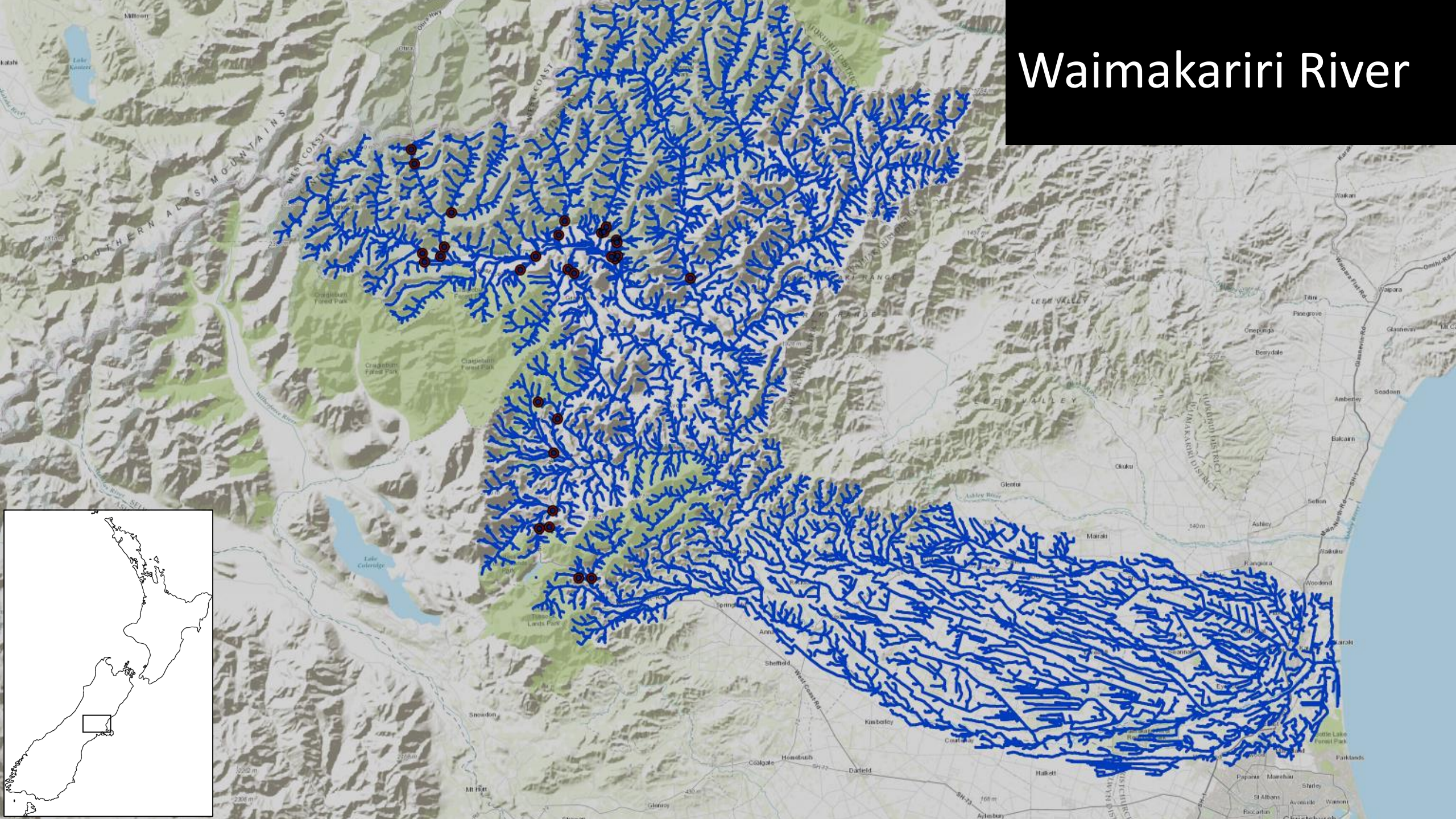
Examine the effects of species composition

Methods

- Compare fish size and trophic position between reaches/streams with range of flow and flood-proneness
- 30 reaches in the Waimakariri catchment headwaters



Waimakariri River



Methods: Fish and invertebrate data

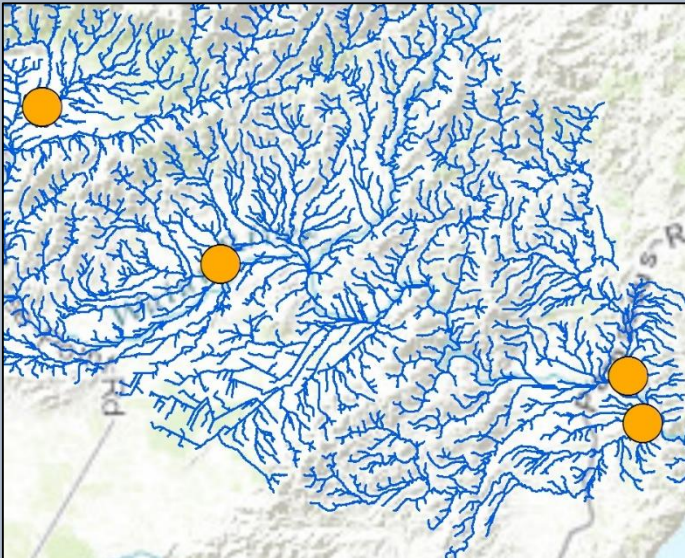


- Fish body size
 - Single pass electrofishing
 - Abundance, species, TL of all fish in 50 M reach



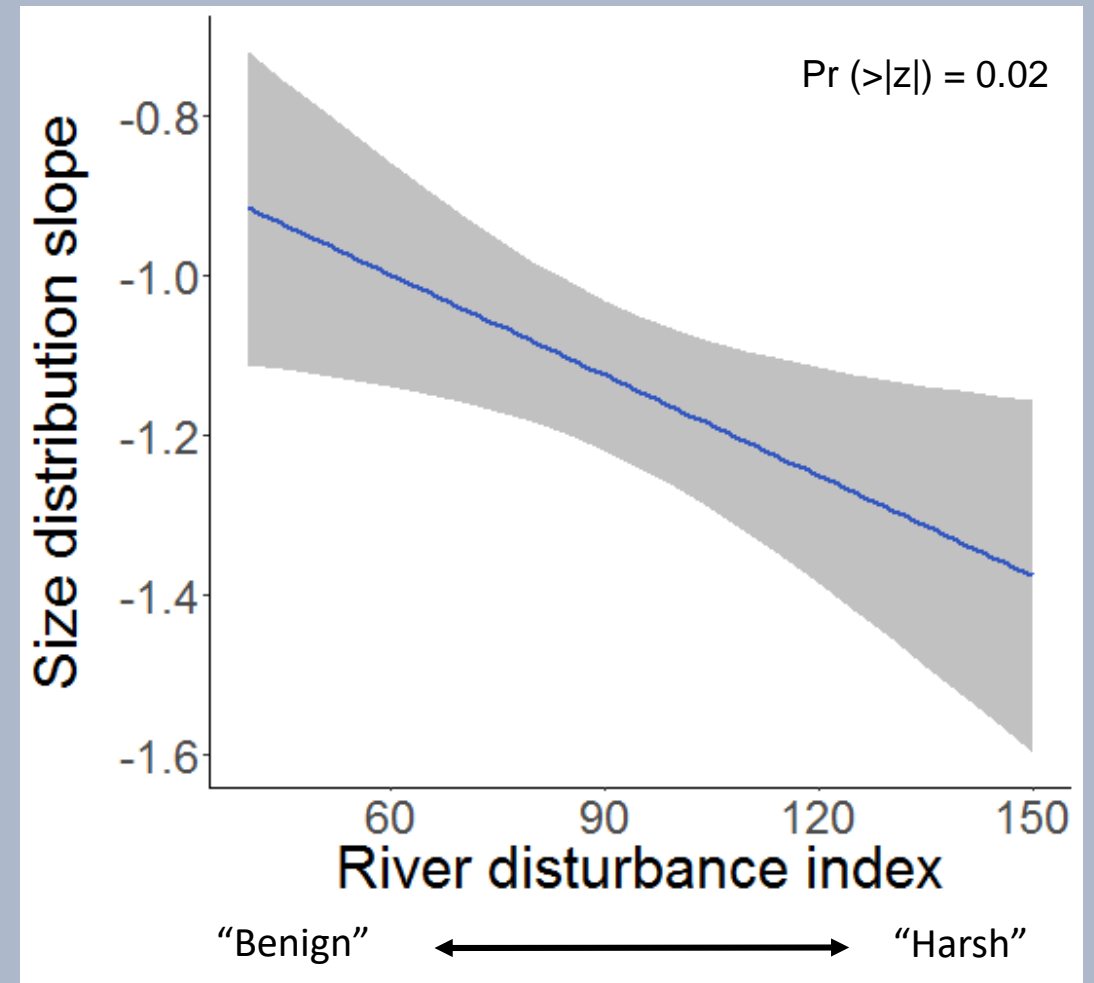
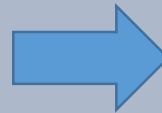
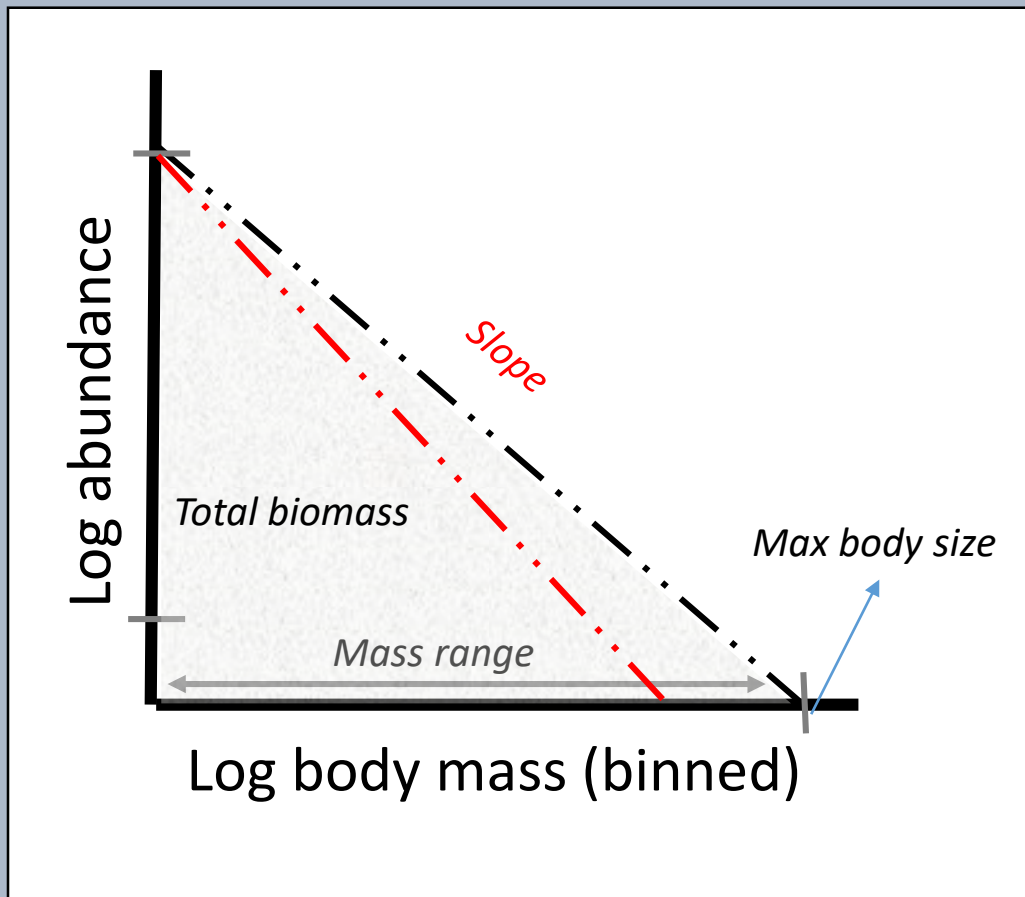
- Food chain length (FCL)
 - N=6 fish from each reach
 - Representative body sizes and species
 - Stable isotope values of fish related to invertebrate baseline

Methods: Habitat data

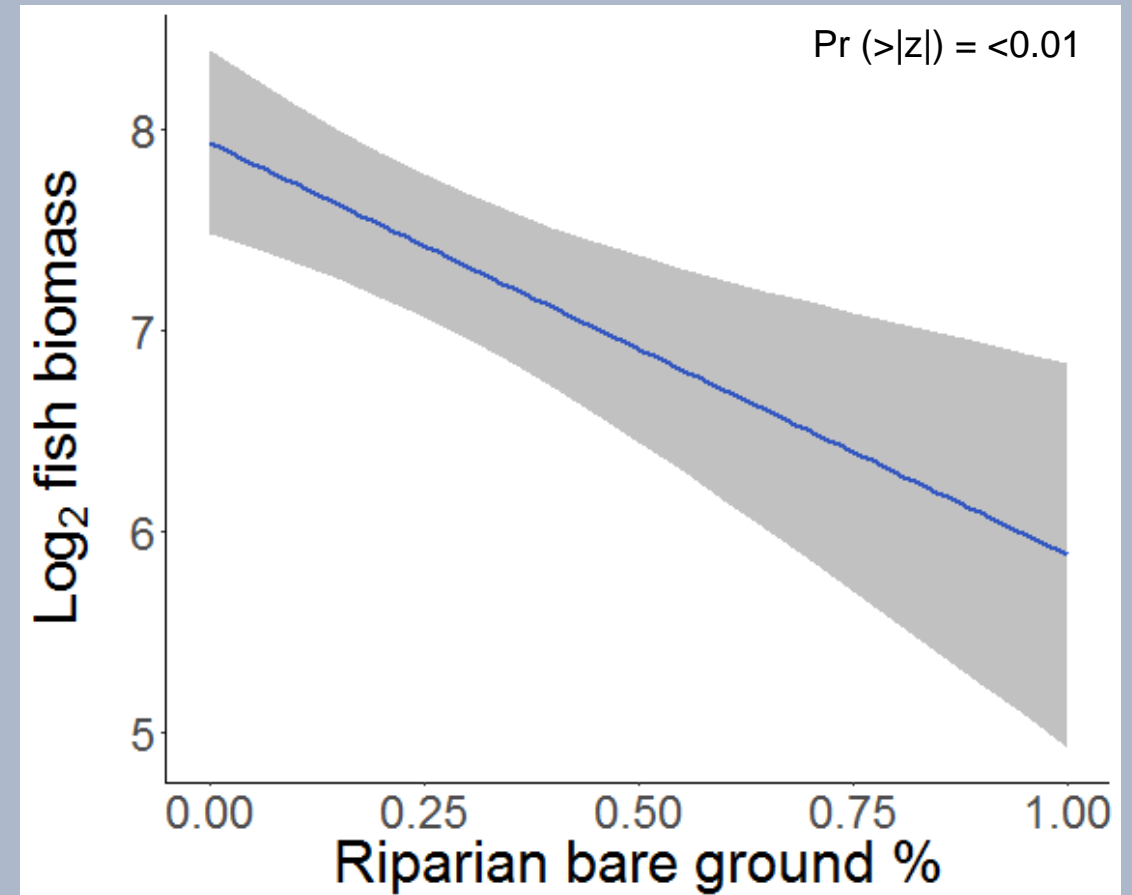
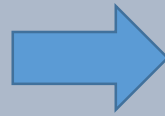
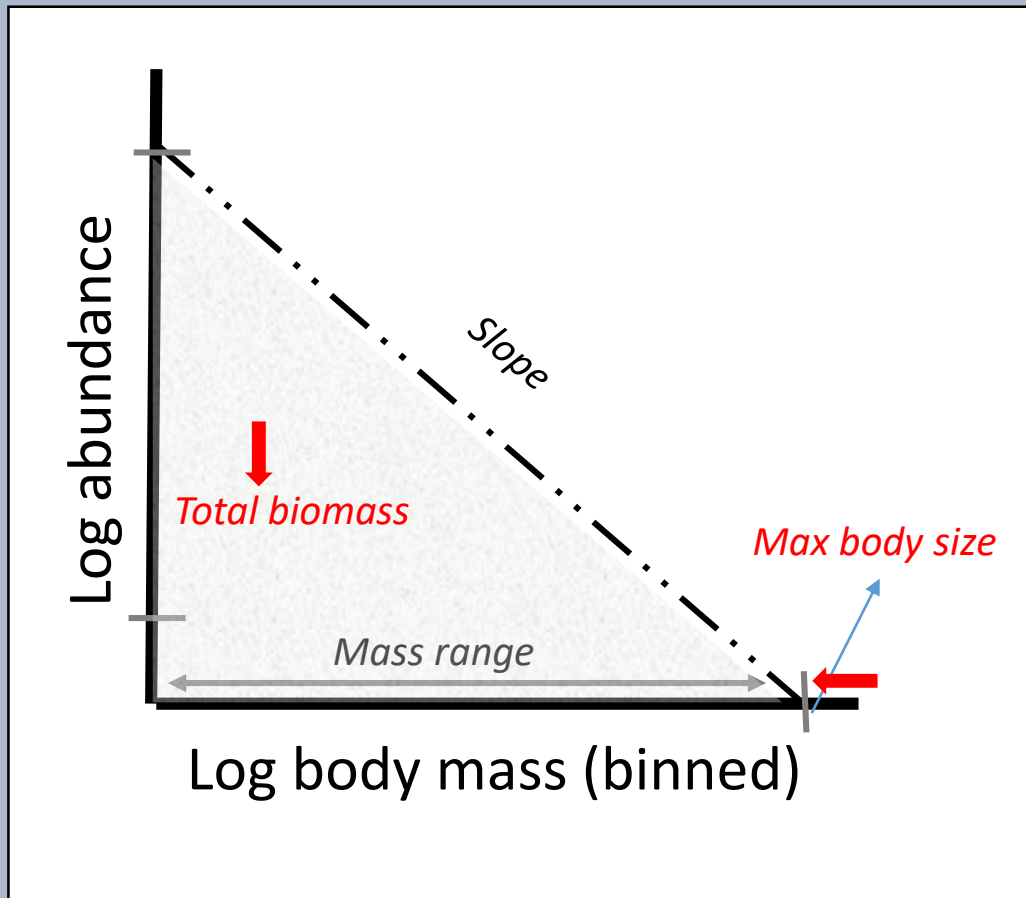


- Habitat
 - River disturbance index (RDI), dimensions, flow
- Satellite image-derived variables
 - From Freshwater Environments of New Zealand (FWENZ)
 - Included riparian bare ground, native bush, tussock, and scrub cover %
- Mixed effects models

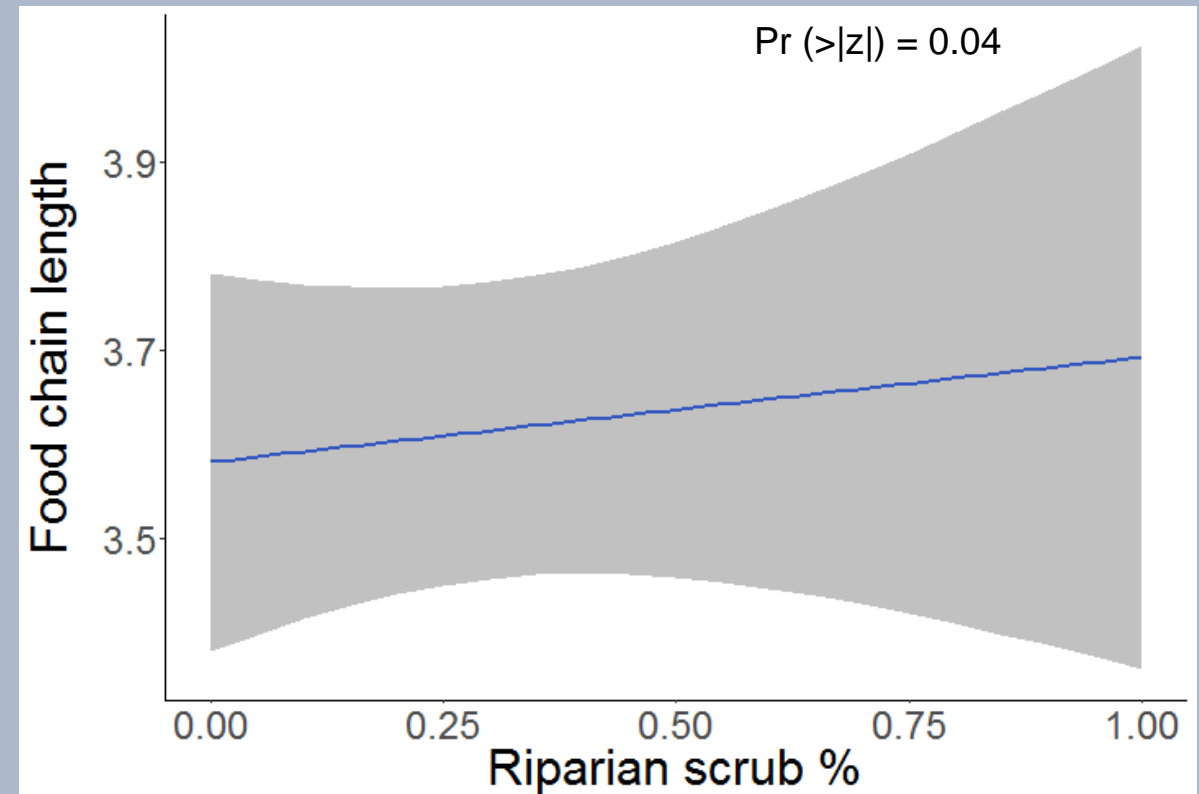
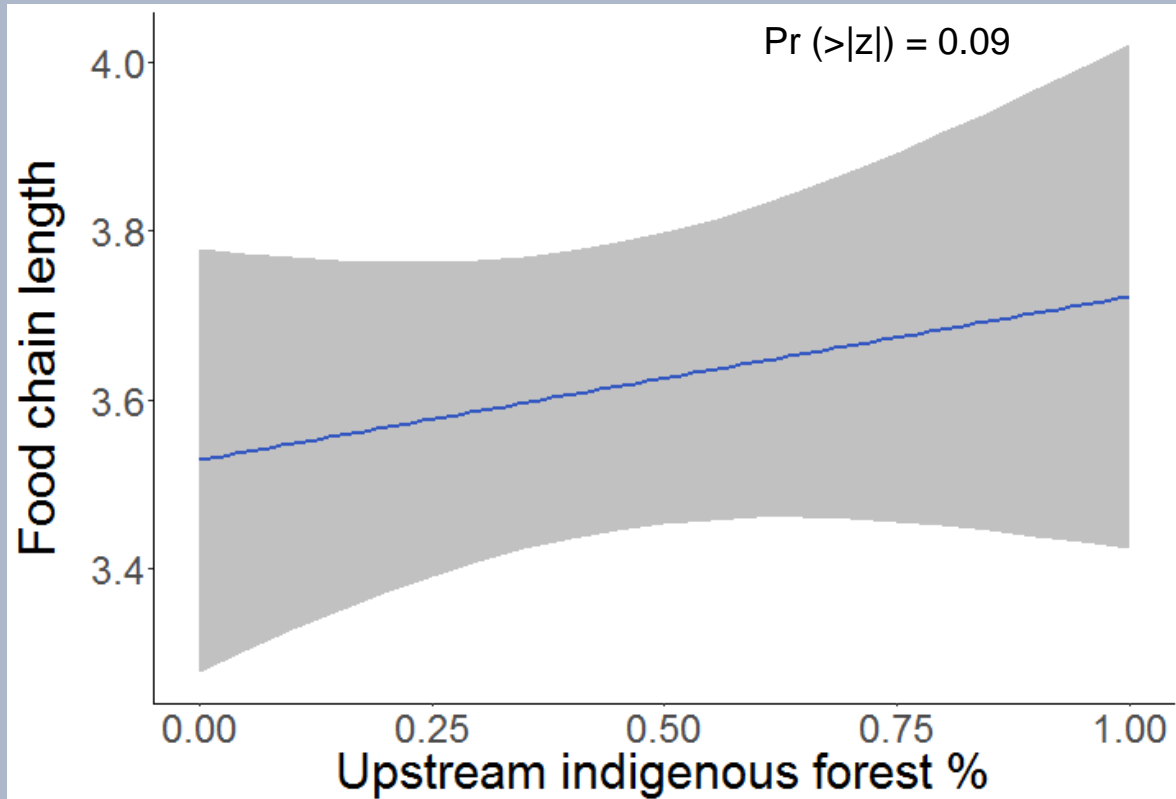
↑ Flood-proneness = ↓ Mass-abundance Slope



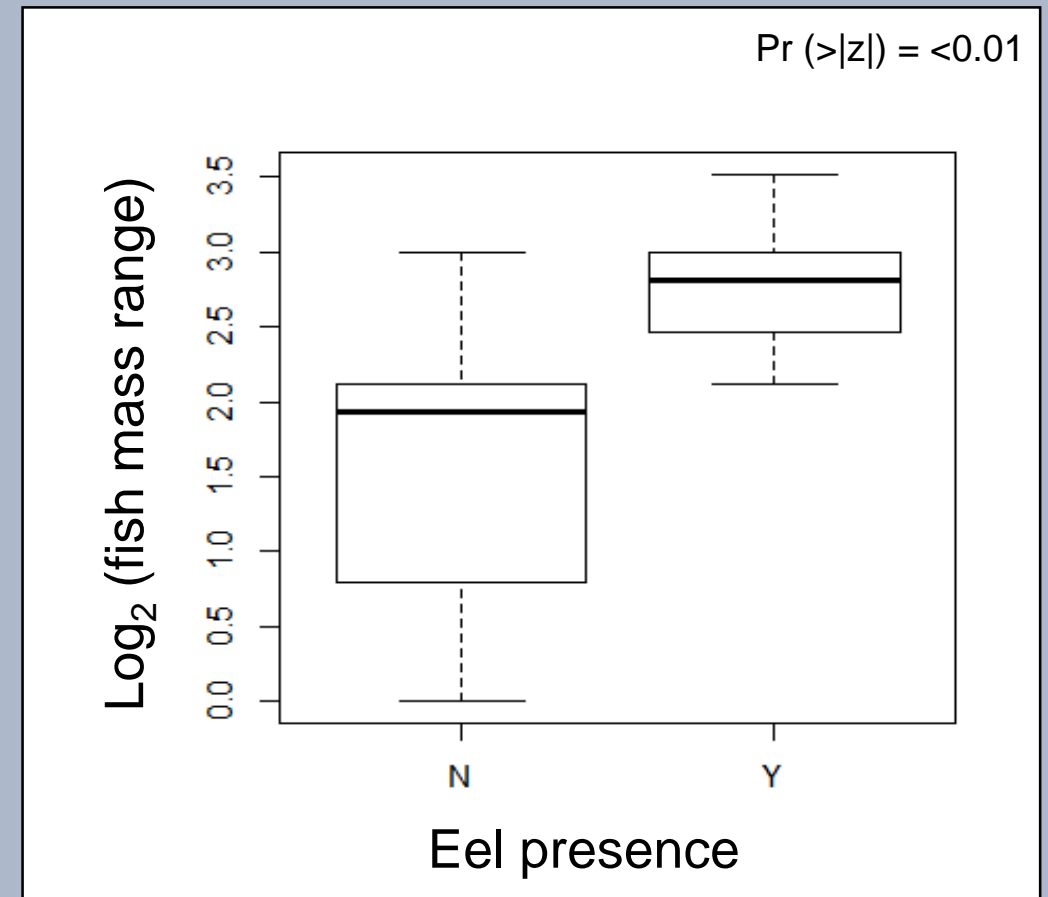
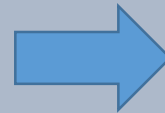
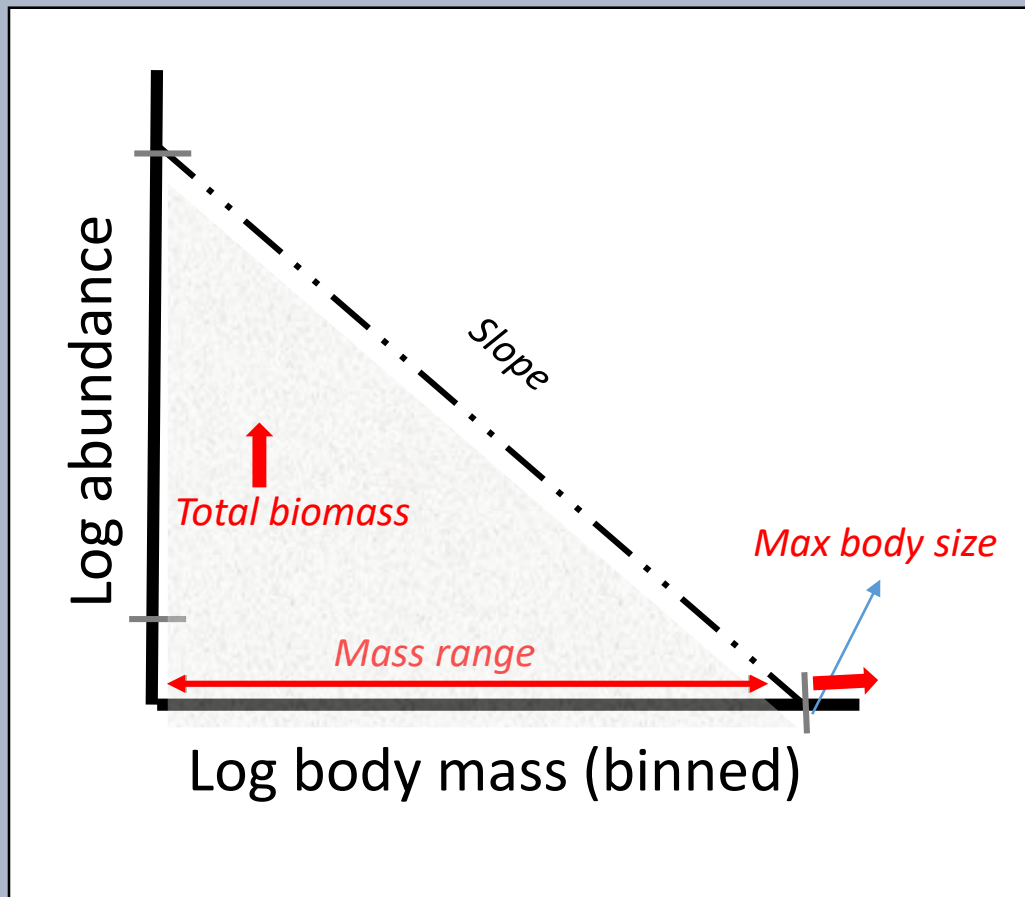
↑ Riparian bare ground % = ↓ Max size, Biomass



↑ Upstream indigenous forest % =
↑ Riparian scrub % = ↑ FCL

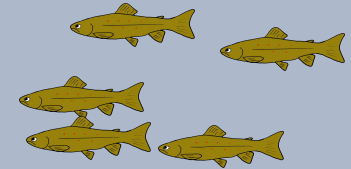


Longfin eel presence =  Max size, Biomass, Size range, FCL

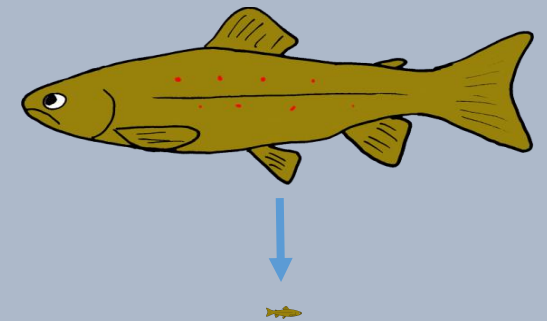
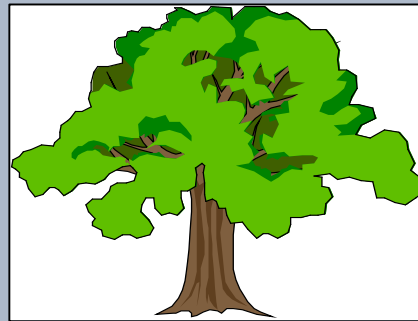


Conclusions

Flood-prone and bare ground reaches support lower biomass and lower maximum body size

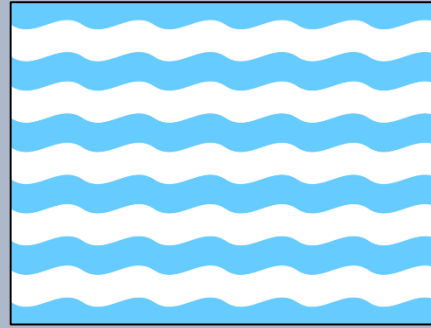


Native bush and riparian vegetation boost food web structure

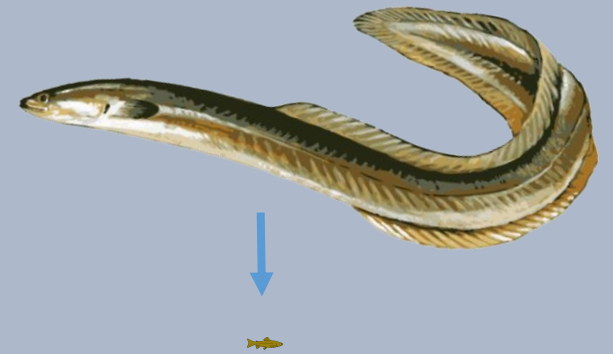
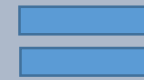


Conclusions

Discharge less important in this catchment for explaining fish communities. Flow pattern likely more useful, but not measured



Longfin eels are clearly the keystone species in the Waimakariri, their presence affected almost every community measure



Implications

Flood-prone and braided reaches can be harsh environments for fishes, supporting fewer individuals, which may give adapted native fishes an advantage over non-native salmonids

Preservation of riparian vegetation and native forest is important for healthy freshwater communities

Eels have a disproportionately large effect on aquatic communities and need to be carefully conserved

Future research

Examine the influence of flow, flood-proneness, and land-cover over multiple catchments

Evaluate effect of surface water abstraction on fish assemblages

Quantify link between fish body size and stable isotope measures

Acknowledgements

Supervisor: Angus McIntosh, University of Canterbury

Postgraduate committee members: Phil Jellyman, NIWA;
Helen Warburton, University of Canterbury;
Dave Kelly, University of Canterbury

Field assistance: Chris Meijer, Nixie Boddy, Richard White.



**Freshwater
Ecology Research
Group**

School of Biological Sciences





Questions?