

# New Zealand's whitebait fishery: a mixed bag of species and sizes.

Implications for policy development and implementation.





# About me

## Freshwater



## Terrestrial



## Marine





# Life Cycle of whitebait - Inanga

Adults live in freshwater



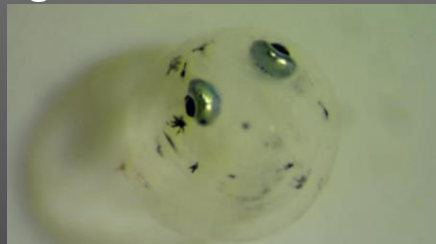
Larvae develop in the sea for 5-6 months and return as whitebait



Adults lay eggs on spring tide on bankside vegetation



Eggs develop for 4 weeks and hatch and go to sea on next spring tide



# Shoaling whitebait = mixed species







5 species of galaxiids

Inanga



Koaro



Banded Kokopu



Giant Kokopu



Shortjaw Kokopu





Giant kokopu



Banded kokopu



Shortjaw kokopu



Koaro



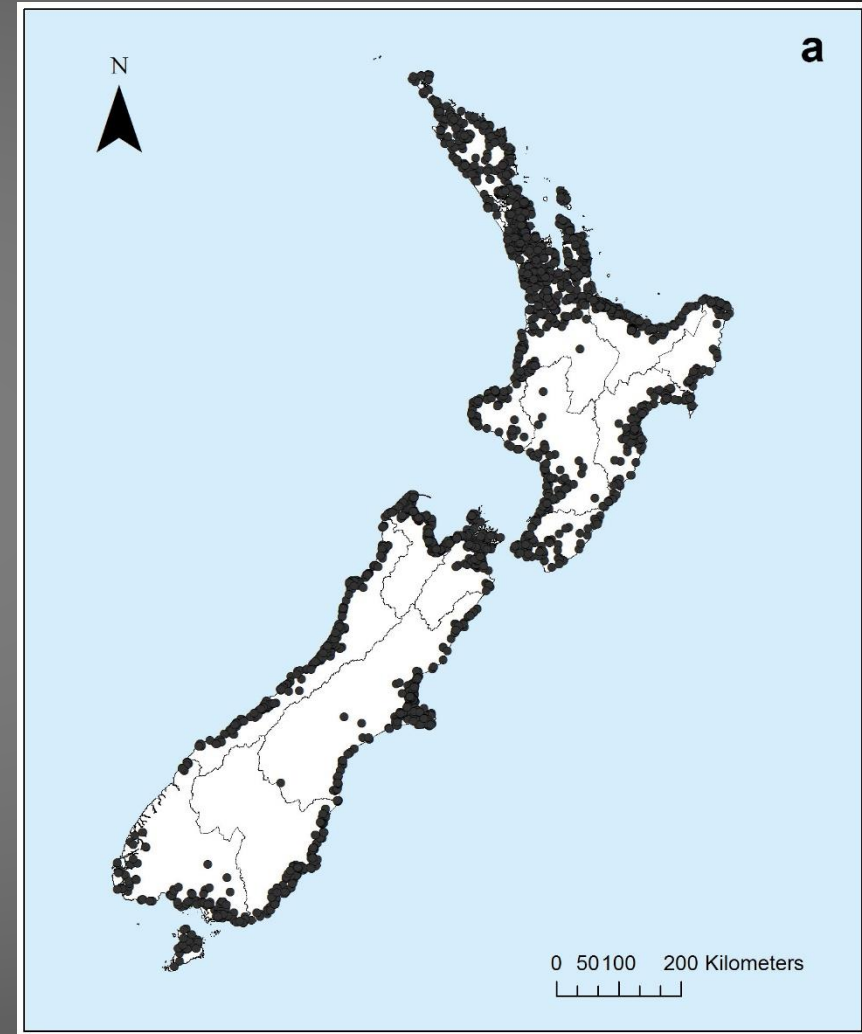
Inanga



Common Sizes of Adult Whitebait Species

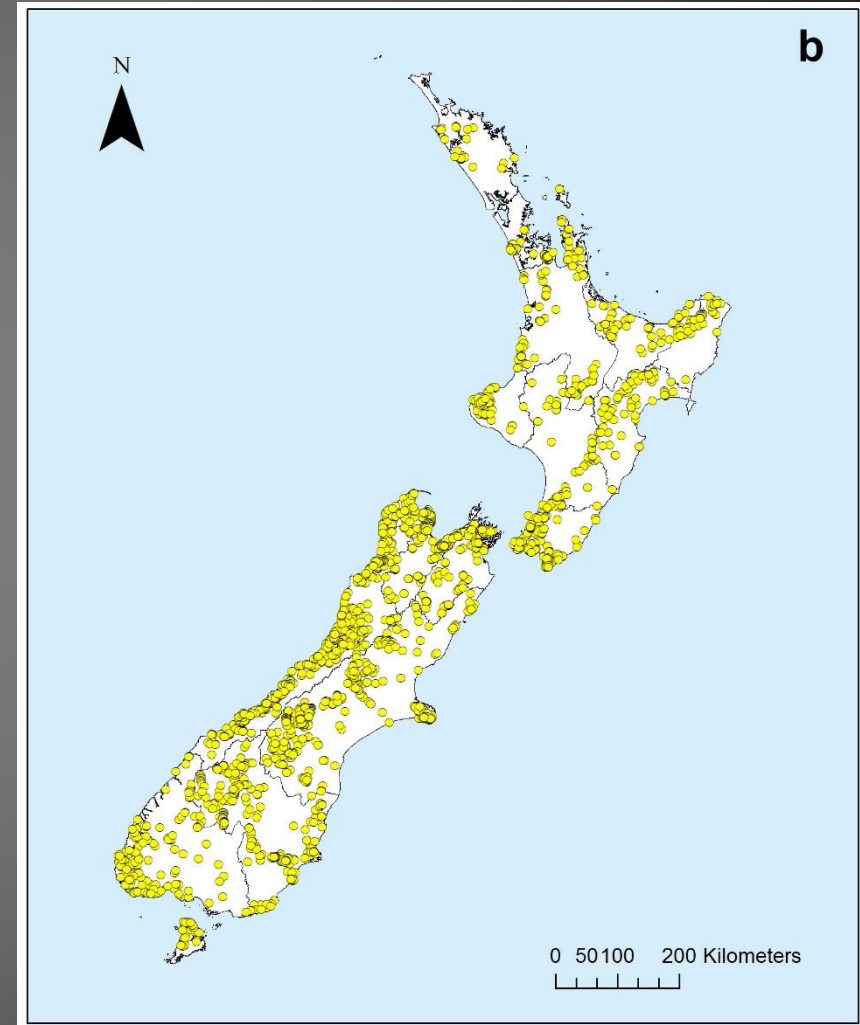
# Inanga (*Galaxias maculatus*)

- Widely distributed throughout New Zealand
- Live in low elevations near the coast
- Poor climbers
- Make up the majority of the whitebait catch
- Threatened – At Risk (Declining)



# Koaro (*Galaxias brevipinnis*)

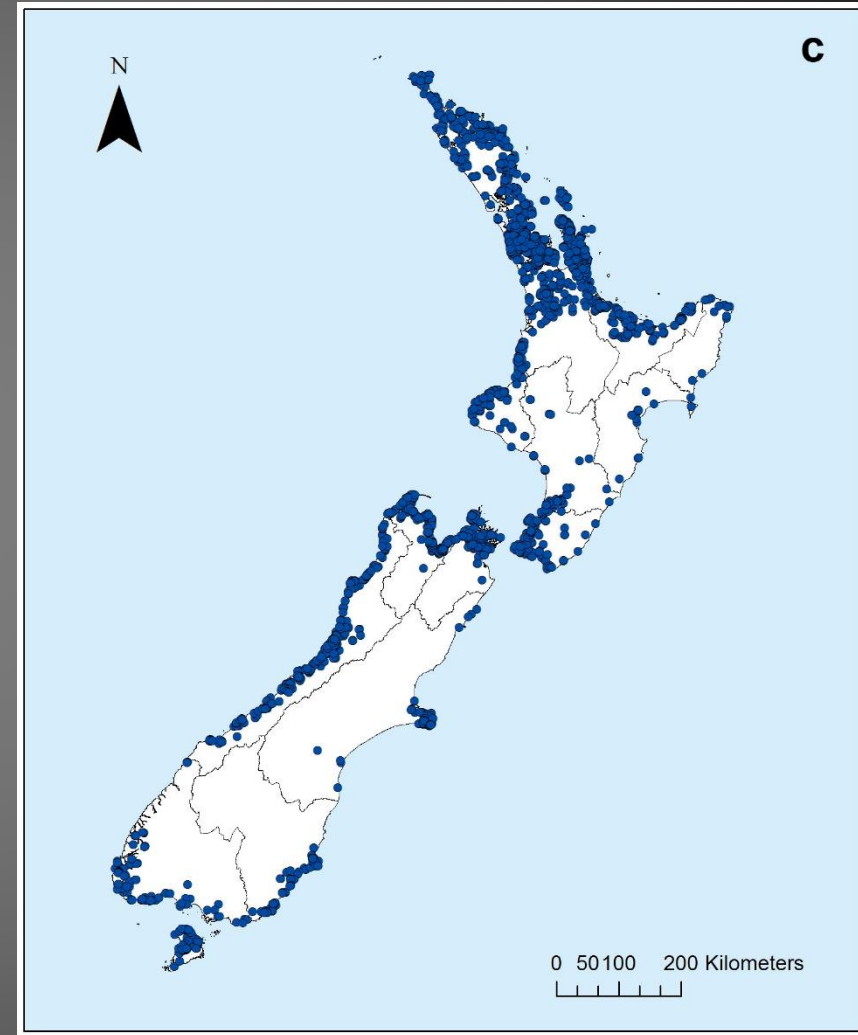
- Widespread throughout NZ
- Penetrate well inland
- Good climbers
- Fast flowing boulder streams
- Threatened – At Risk (Declining)





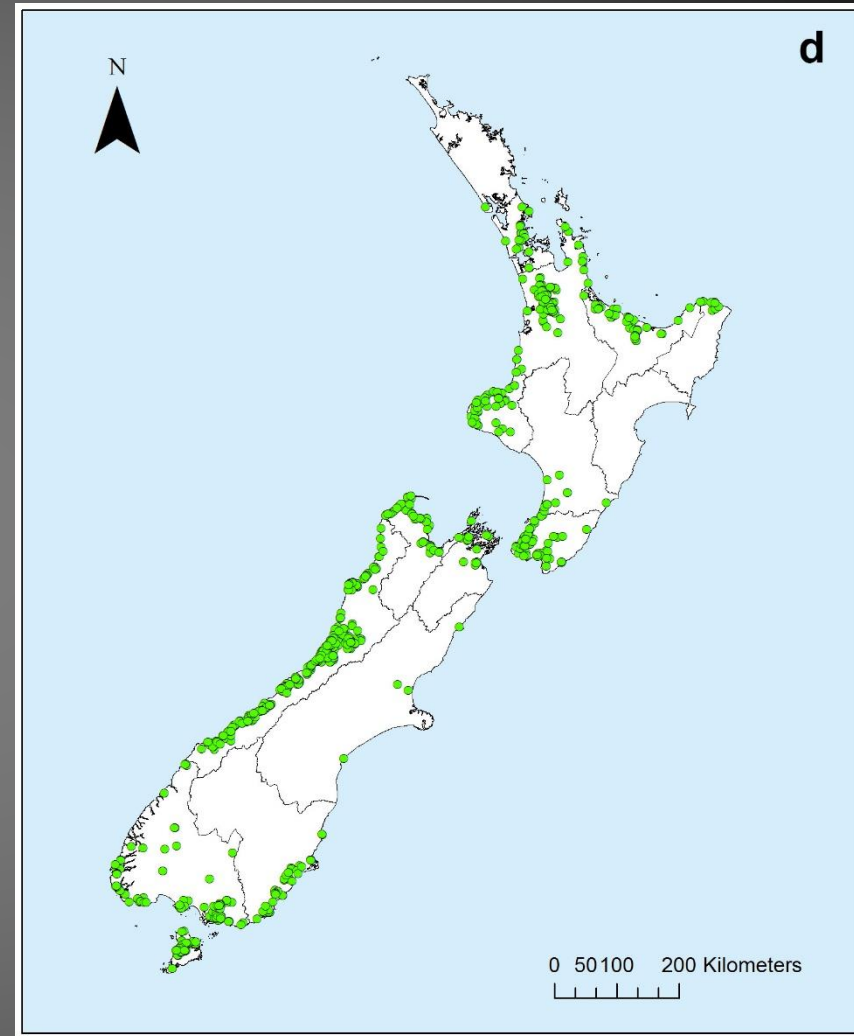
# Banded Kokopu (*Galaxias fasciatus*)

- Widespread but absent from East Coast of both islands
- Good climbers
- Overgrown streams with slow flowing pools
- Cool water
- Not threatened



# Giant Kokopu (*Galaxias argenteus*)

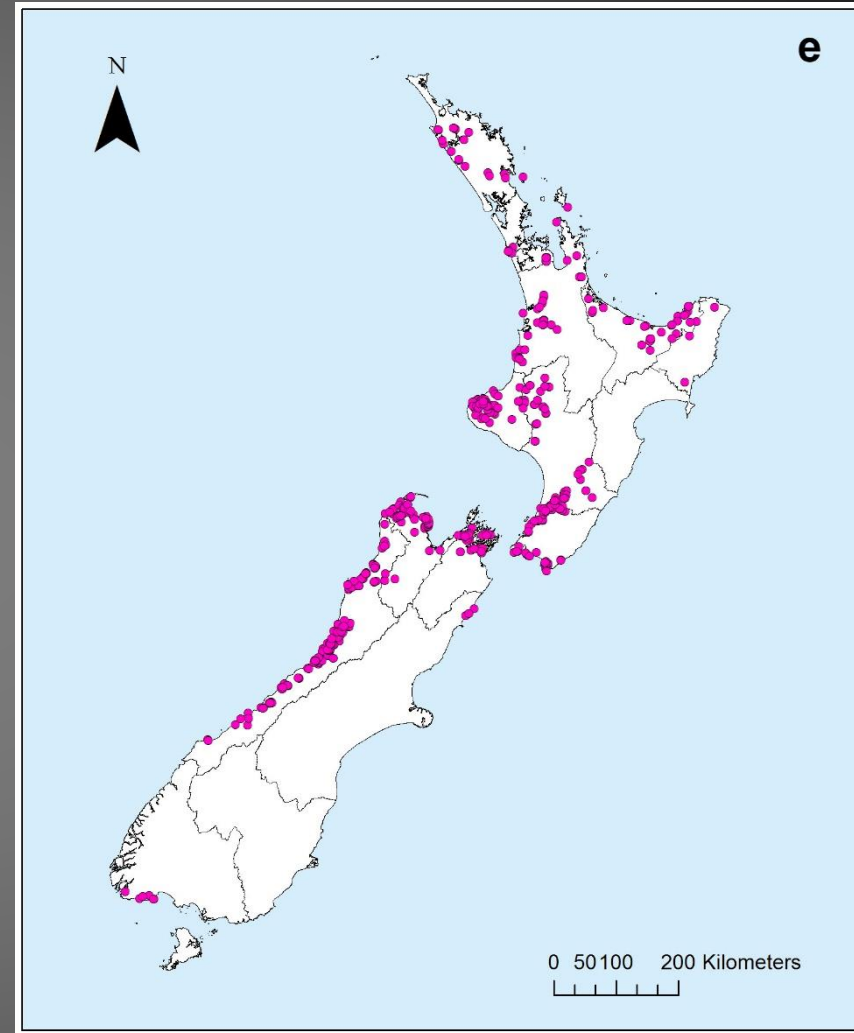
- Patchy distribution
- Deep slow flowing wetland
- Small to medium sized overgrown stream
- Low elevation
- Poor climbers
- Some thought to live up to 50 years.
- Threatened – At Risk (Declining)





# Shortjaw Kokopu (*Galaxias postvectis*)

- Pockets of fish in BOP, New Plymouth, Tasman, West Coast
- Forest covered boulder streams
- Solitary and nocturnal
- Rare
- Threatened – Nationally vulnerable



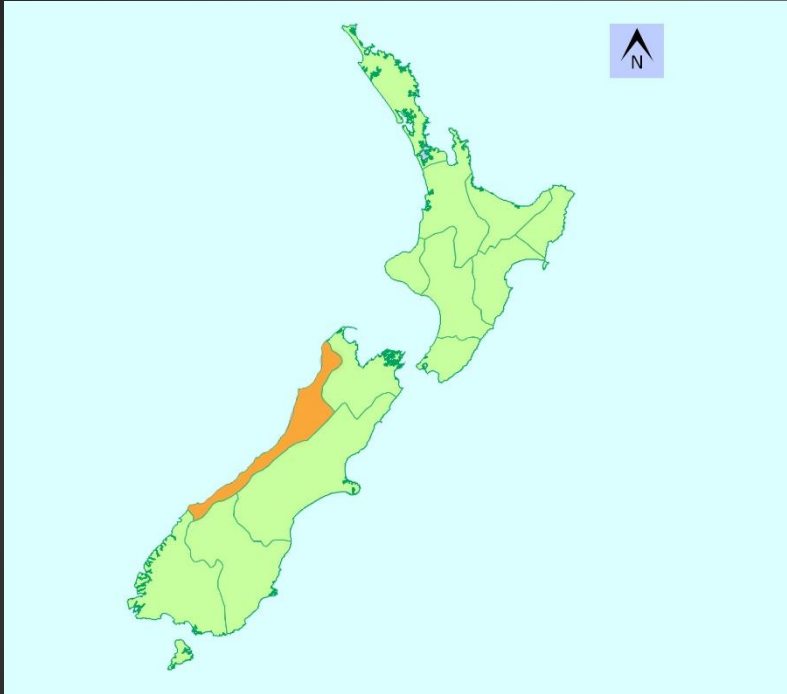
# Why do whitebait research?

- 50 years since last widespread study (McDowall, 1964)
- Land use changes
- 4 of the 5 species threatened
- “Declining catches”
- “Increasing numbers of whitebaiters”
- Need to know basics to:
  - manage the fishery
  - inform policy decisions and implementation





# Why is this important?

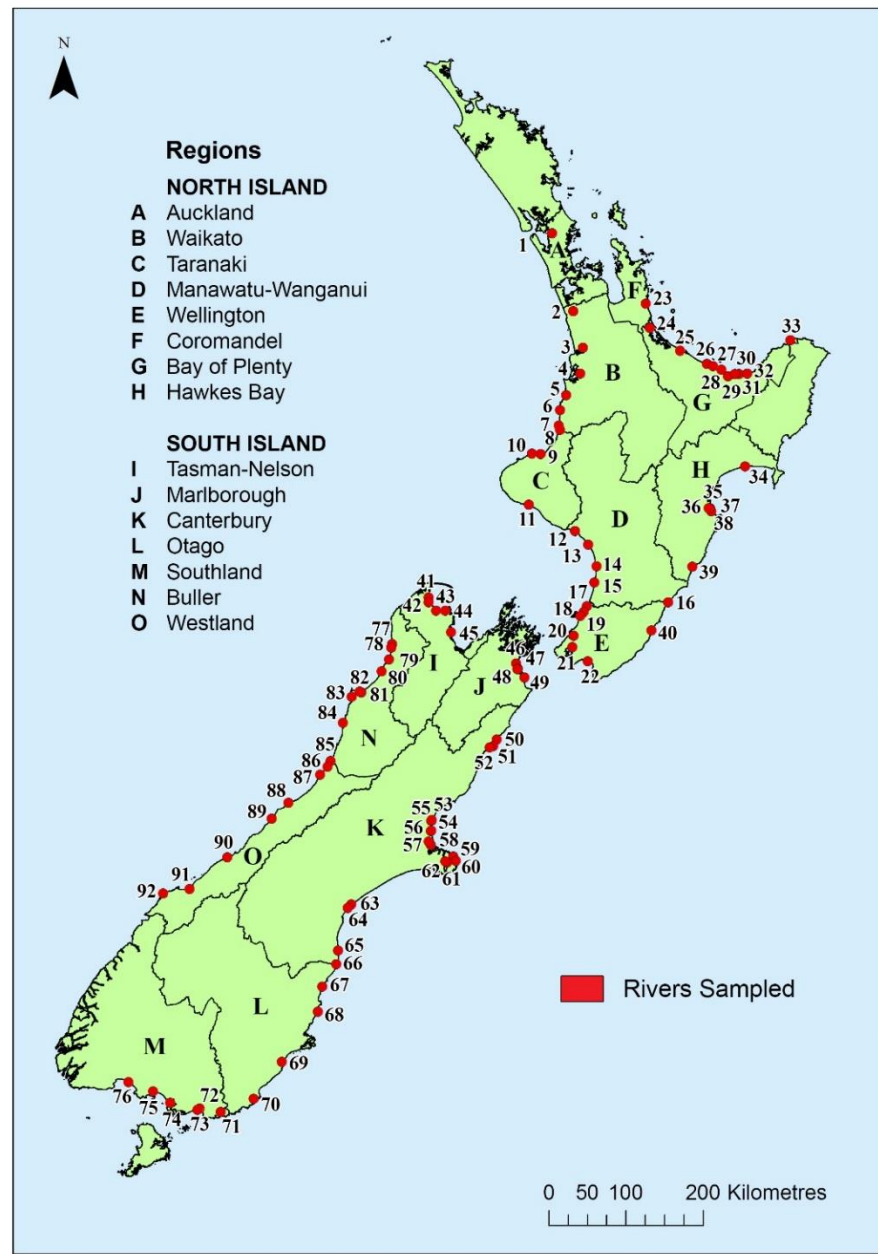


- Fishery is managed as a whole, apart from **West Coast** - different rules.
- **West Coast** rules – back markers, closed rivers, reduced fishing season.
- Rehabilitation and restoration – aim to increase **biodiversity** and **production** of fish and macroinvertebrates.



# Summary of Composition Studies

- Limitations with past studies
- Comprehensive 2015 & 2016 Study





# Research Questions

1. Are there **spatial** and **temporal** differences in composition?
2. Are there spatial and temporal differences in **length** and **weight**?
3. Has the composition of the New Zealand whitebait fishery **changed** in the past **50 years**?
4. Does **forest cover** or **adults** within catchments influence composition?
5. What **implications** does this have for **policy development** and **implementation**?



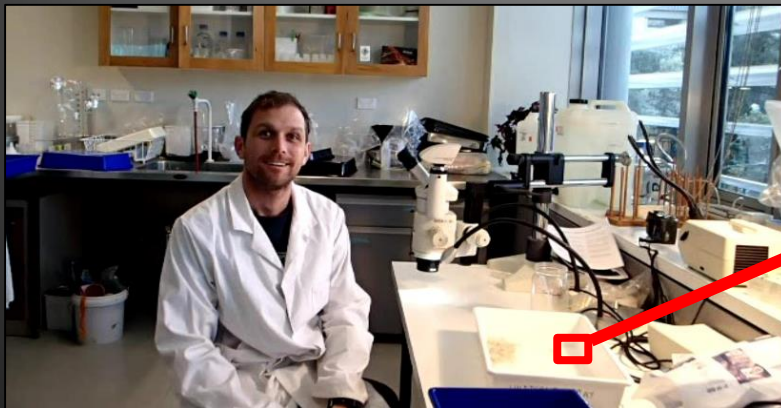
# Methodology

- Scoop net and set net
- Within the tidal reach
- 1<sup>st</sup> July 2015 to 31<sup>st</sup> Dec 2015
- Inside and outside of season
- 14 regions
- Standard whitebait rules
- Fish tested genetically
- Subsample of **200** whitebait from catch



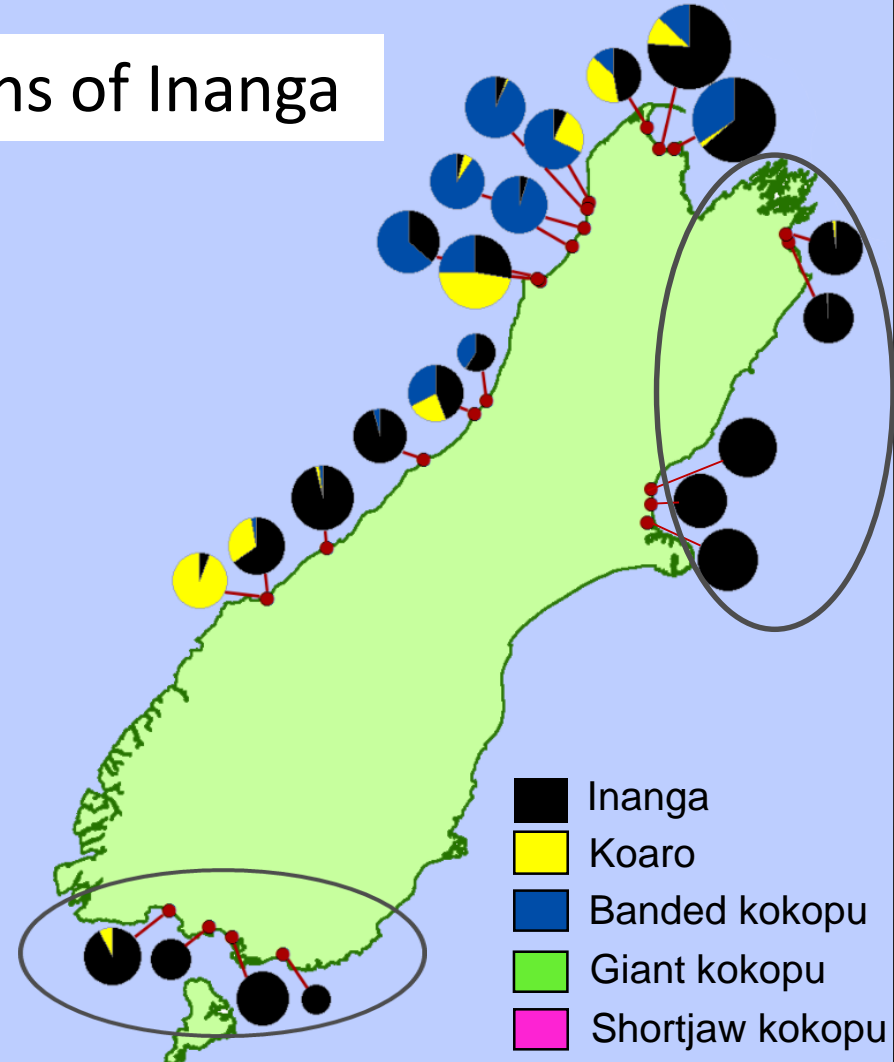
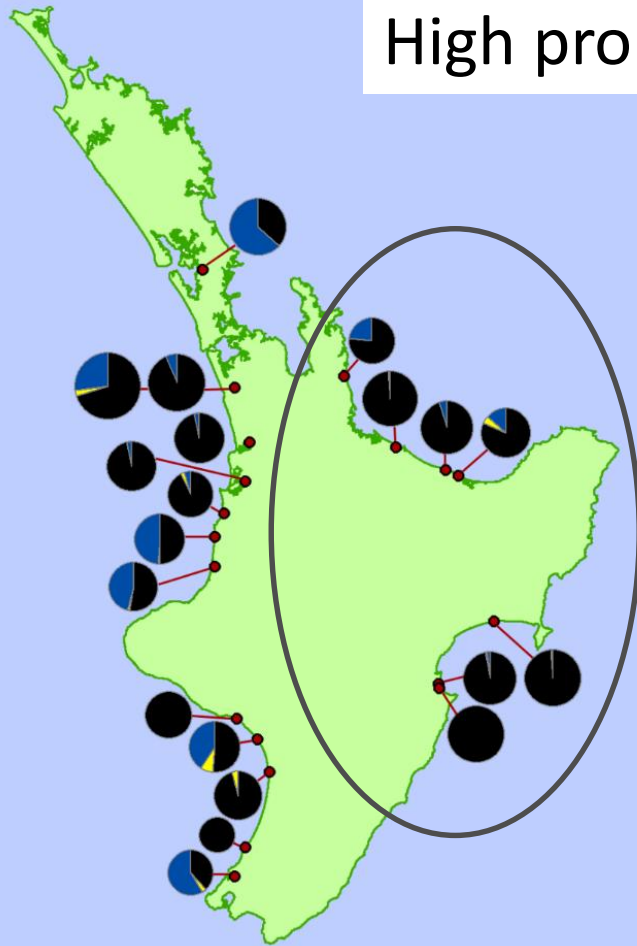


# 92 rivers throughout NZ, total of 500 samples



## Spatial differences in whitebait composition October 2015

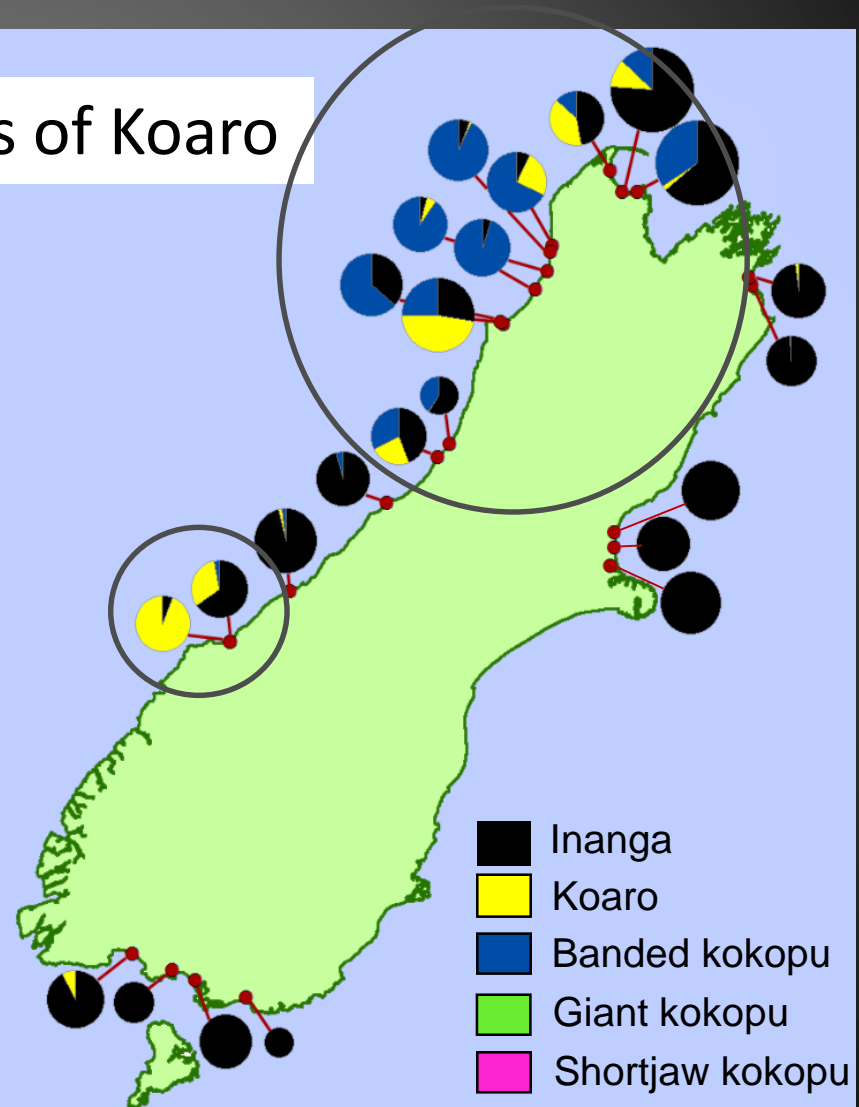
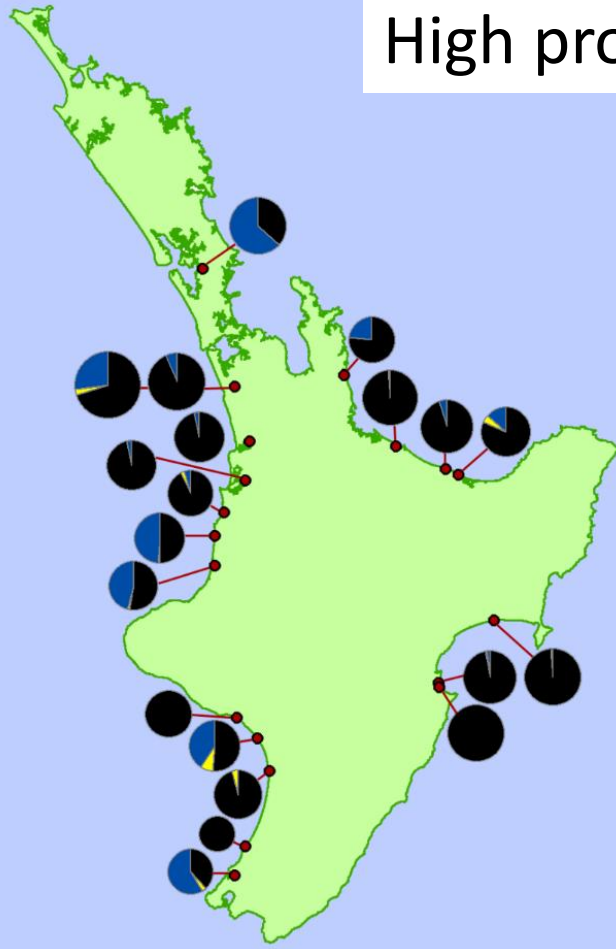
High proportions of Inanga



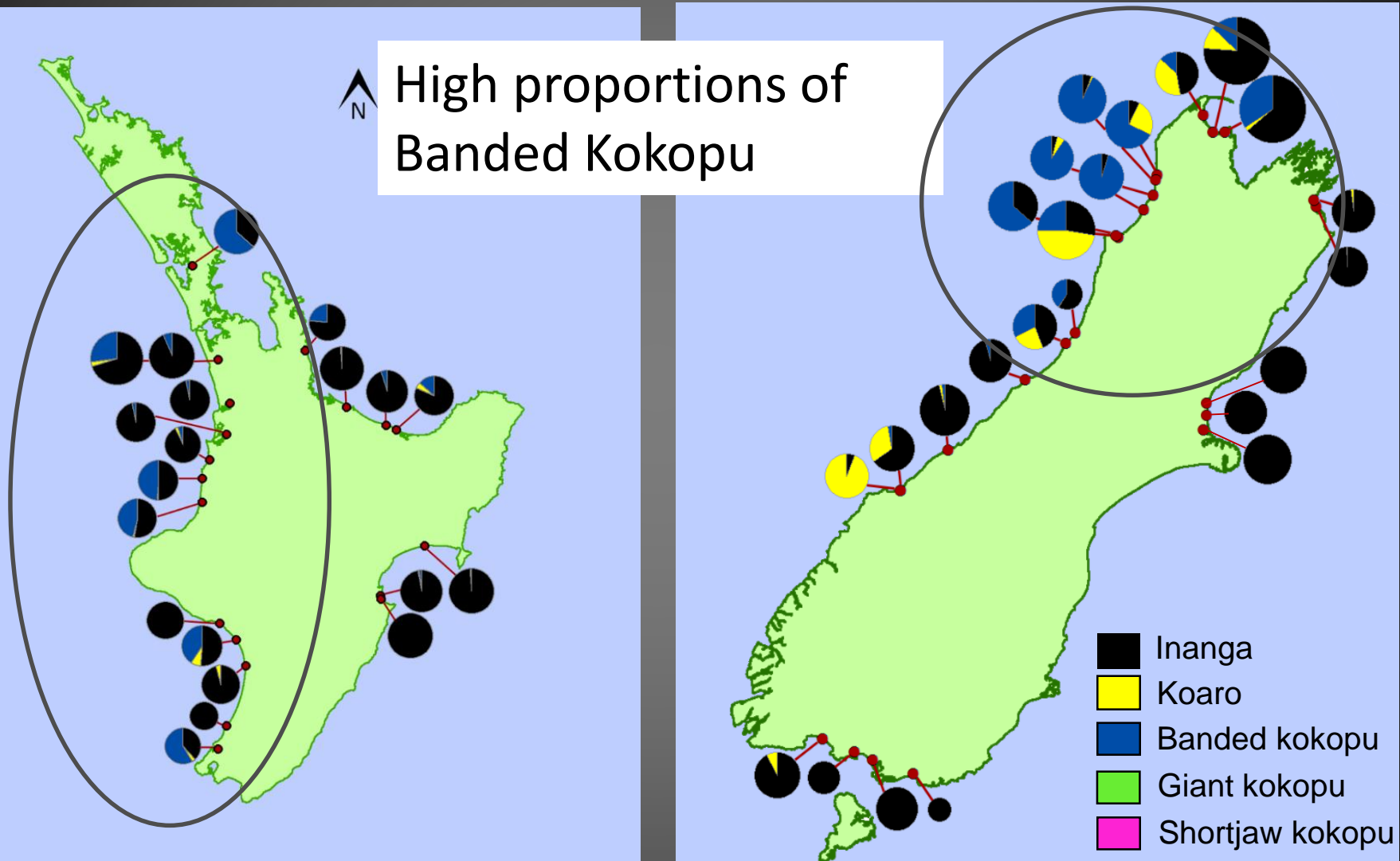


## Spatial differences in whitebait composition October 2015

High proportions of Koaro

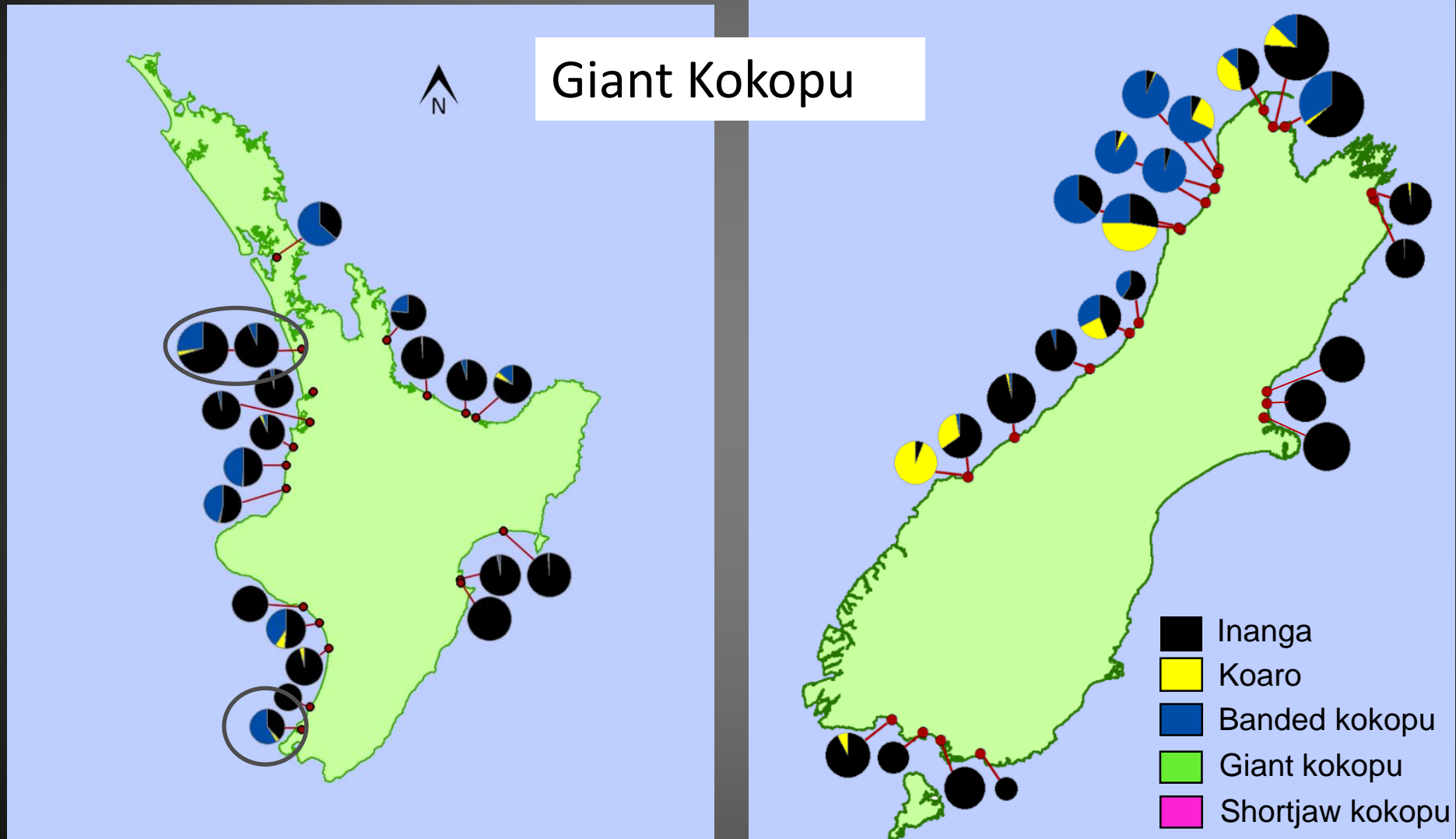


## Spatial differences in whitebait composition October 2015

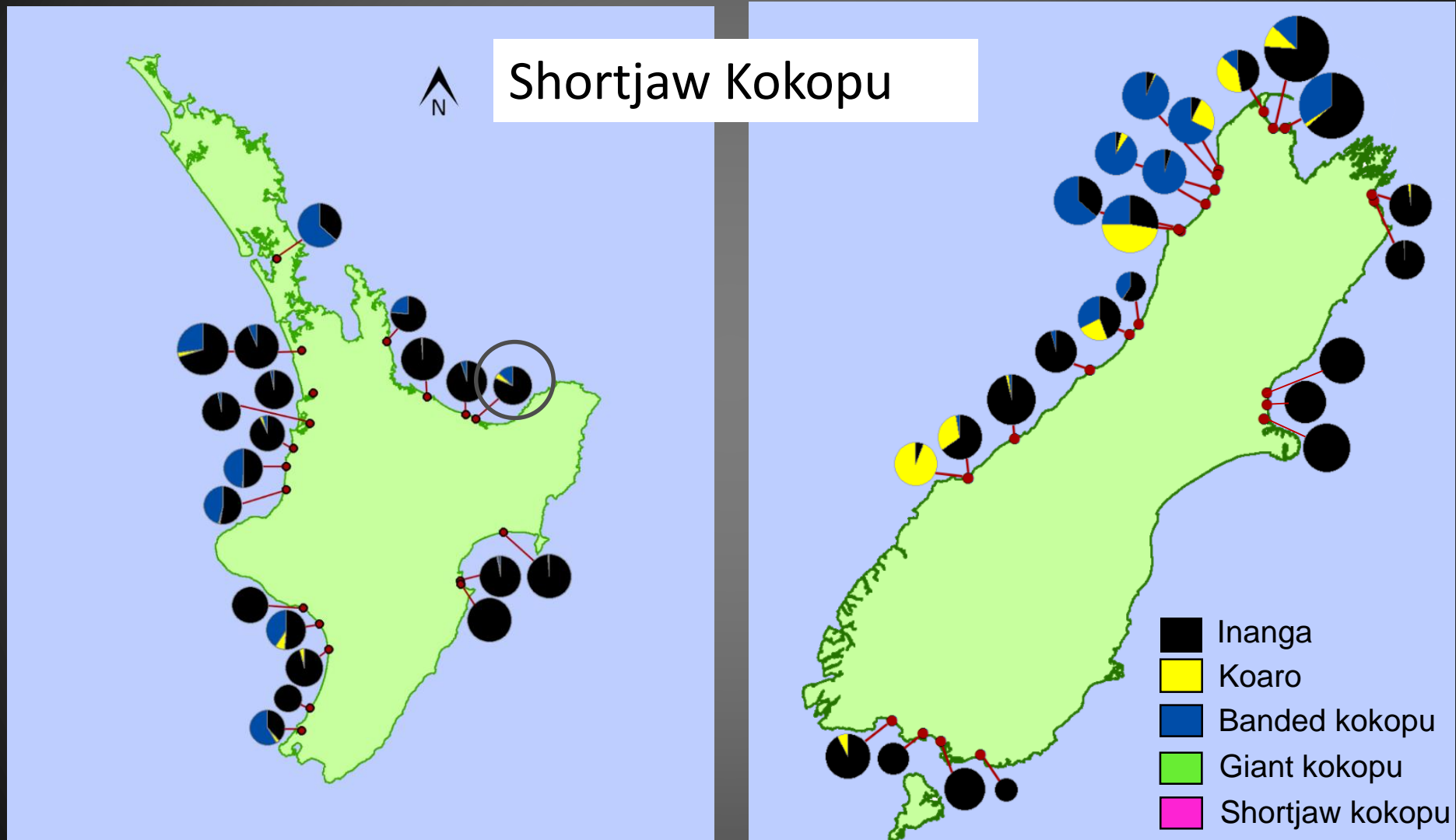




# Spatial differences in whitebait composition October 2015



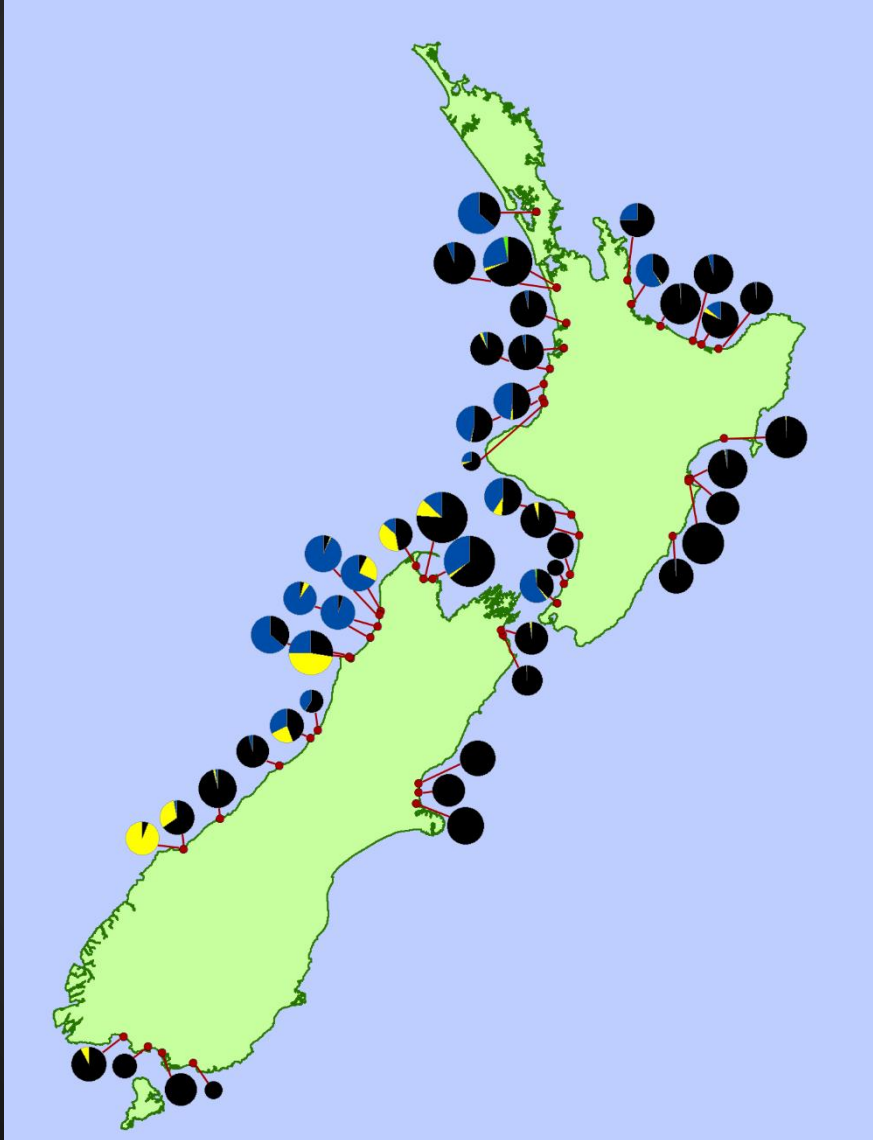
## Spatial differences in whitebait composition October 2015



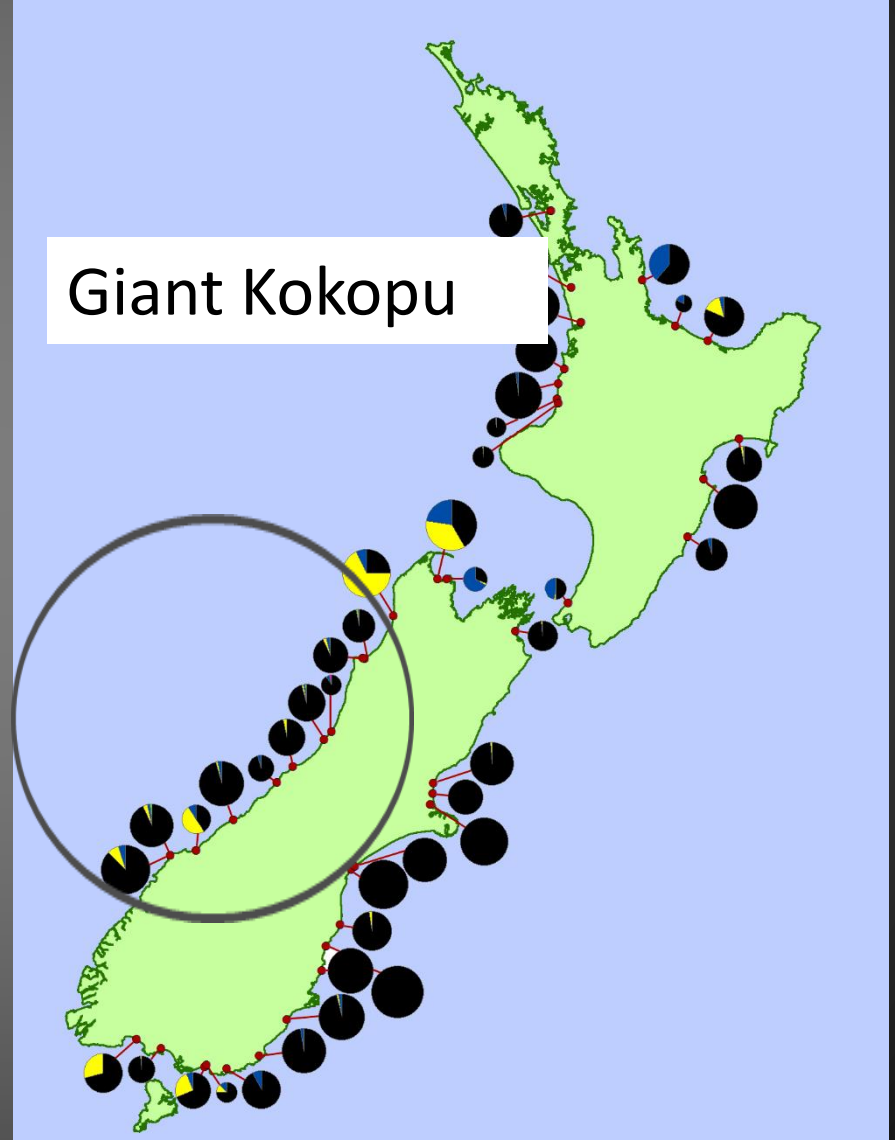


# Summary of composition October & November 2015

October

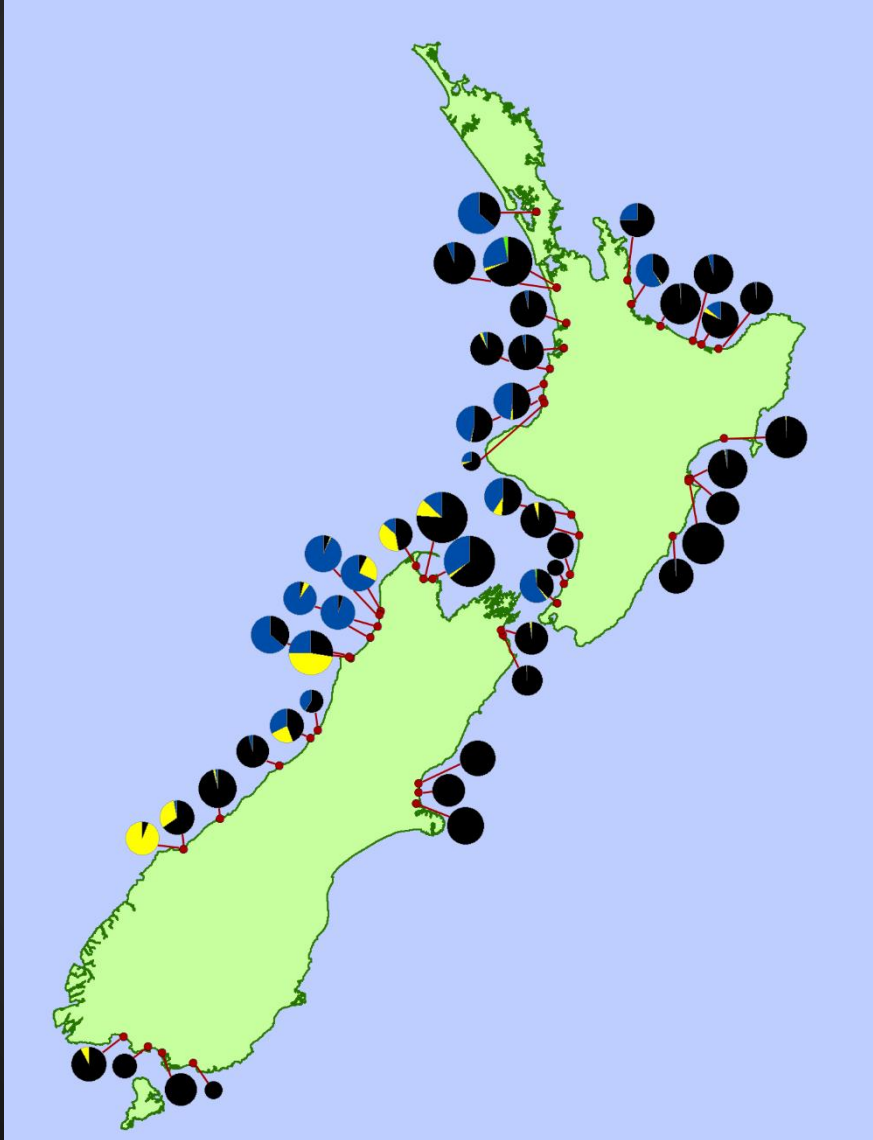


November

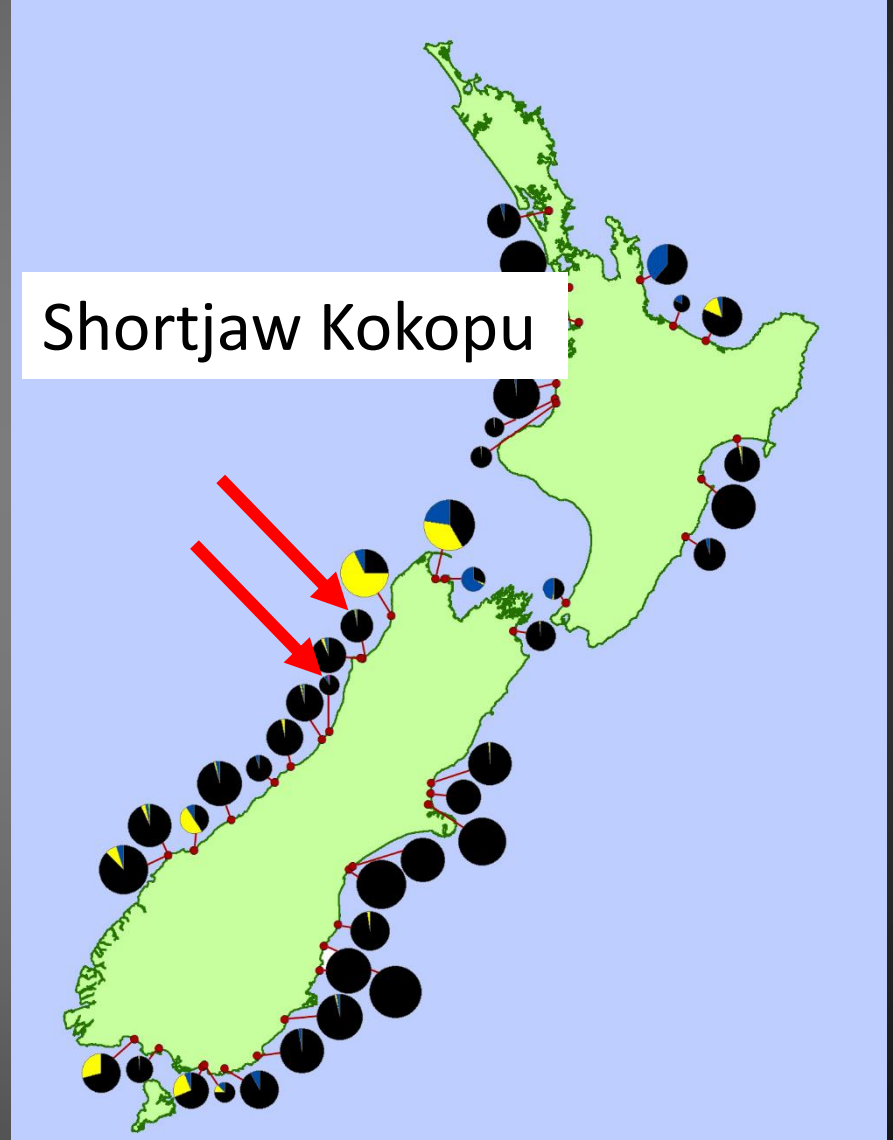


# Summary of composition October & November 2015

October



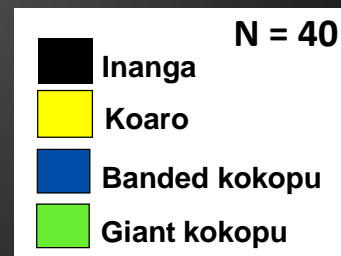
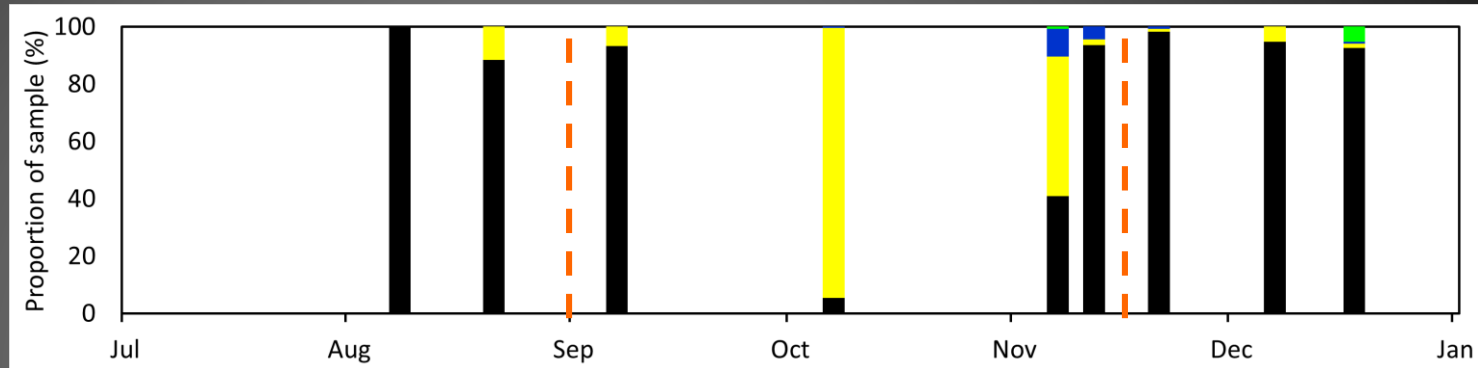
November





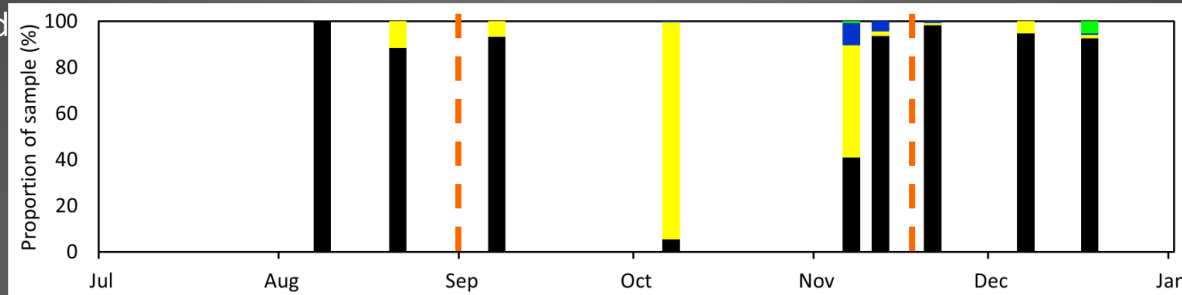
# Temporal differences in whitebait composition 2015

Waiatoto River, Westland

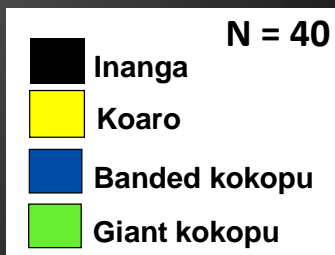
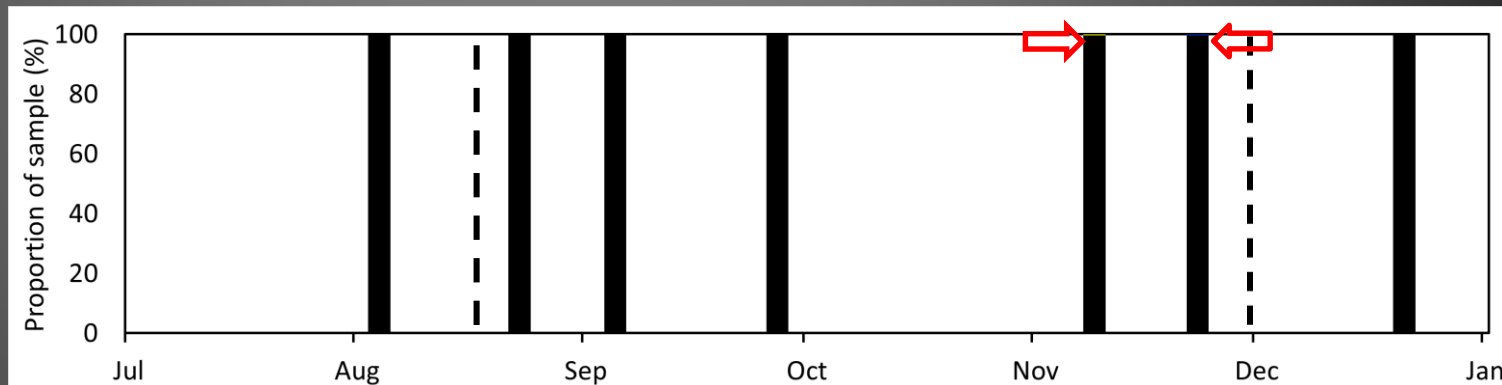


# Temporal differences in whitebait composition 2015

Waiatoto River, Westland



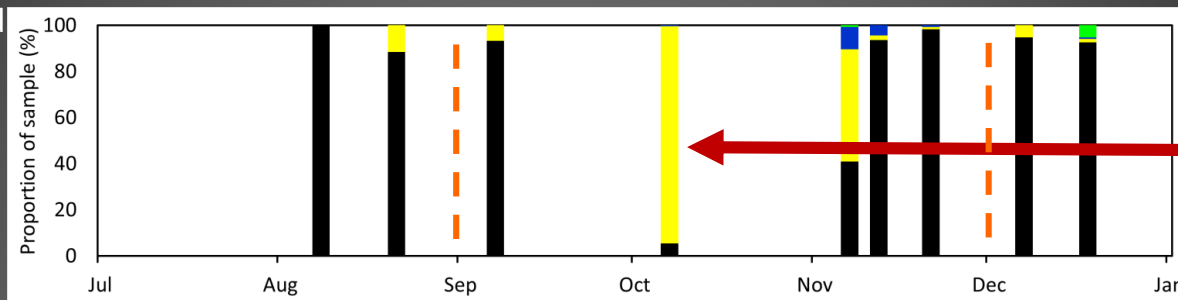
Avon River, Canterbury



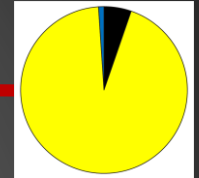


# Temporal differences in whitebait composition 2015

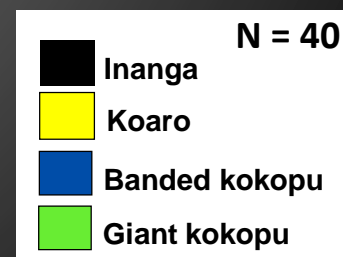
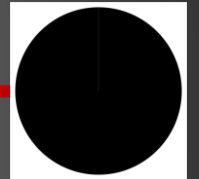
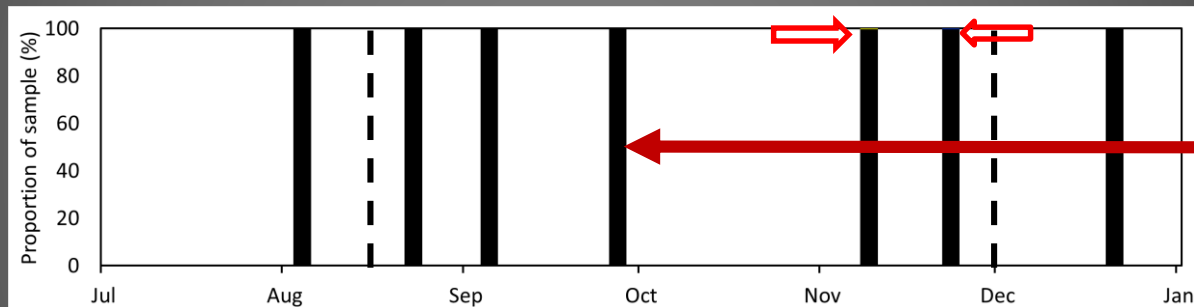
Waiatoto River, Westland



Oct 2015



Avon River, Canterbury



# Why does this vary?

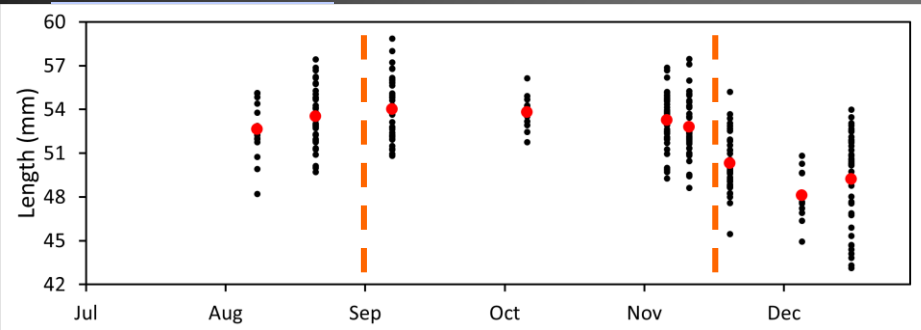
- Differences in river characteristics
- Temperature, pH, clarity, turbidity, river level
- Different timing of spawning
- Varied length of time at sea.



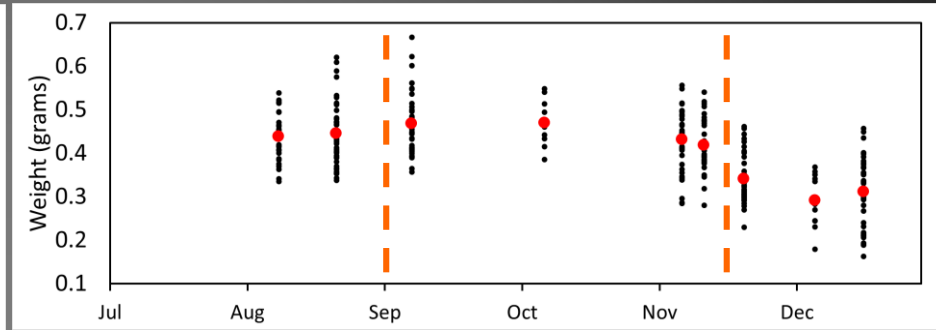
# Temporal differences in **length** and **weight** of Inanga

Waiatoto River, Westland

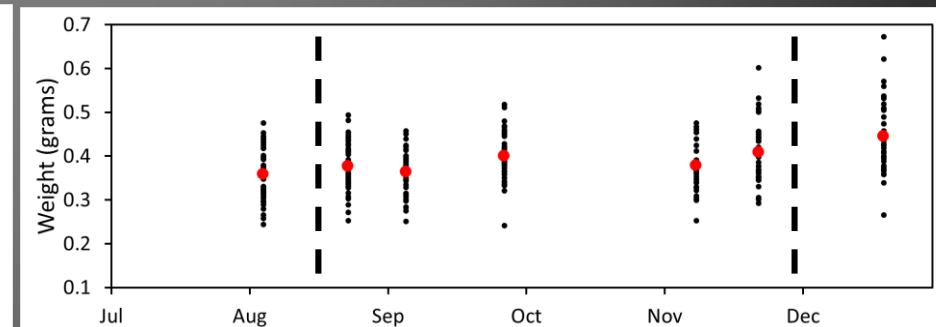
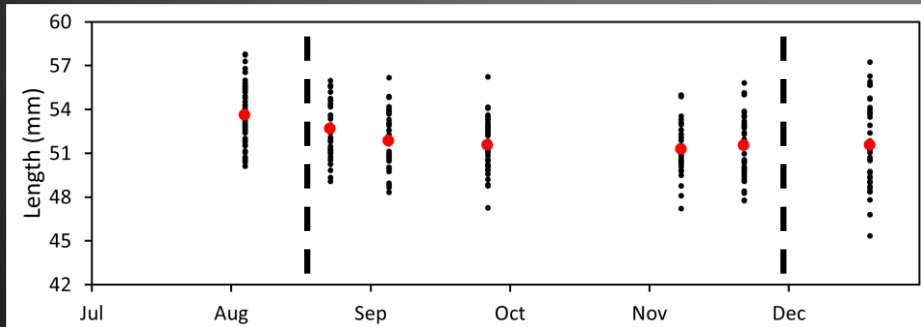
**Length**



**Weight**



Avon River, Canterbury



N = 40



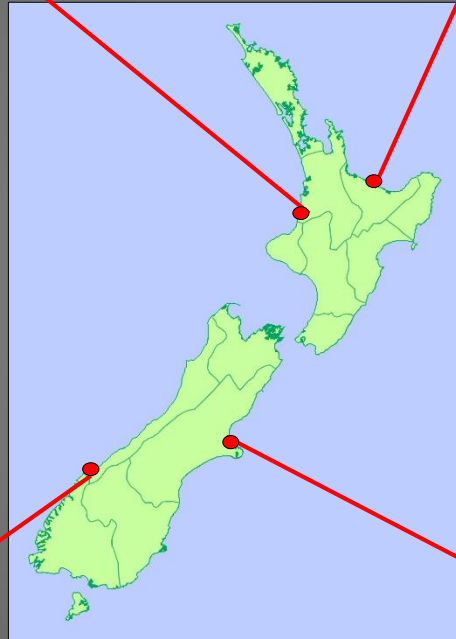
# 1 kilogram of whitebait (inanga) =

Mokau River, Waikato

2941 fish

Kaituna River, Bay of Plenty

3636 fish



Waiatoto River, Westland

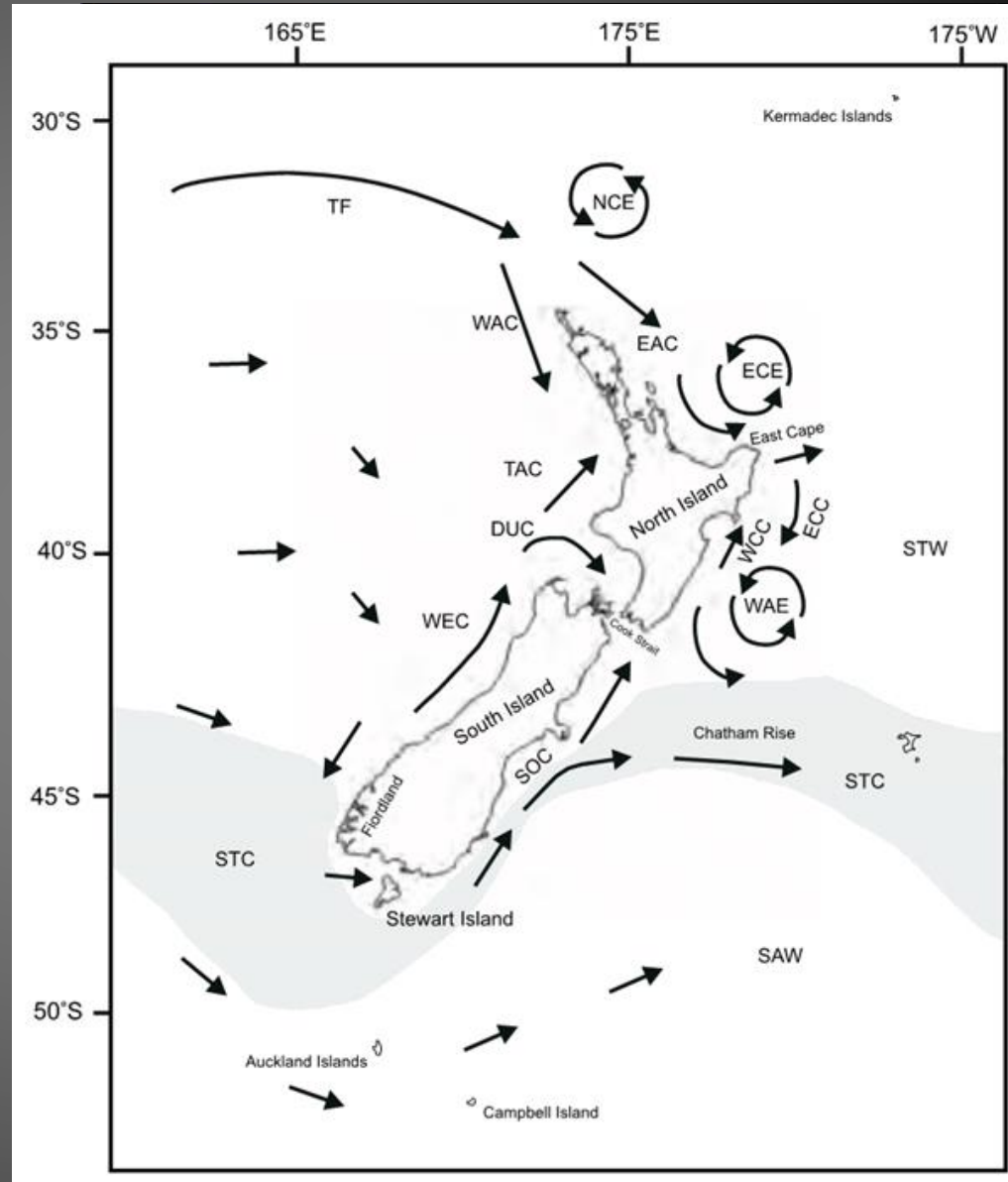
2136 fish

Avon River, Canterbury

2652 fish

# Why is there variation?

- Oceanic environments may be different in:
  - Different regions
  - Different times of the year
- Affecting what they can eat and growth
- Temperature, ocean currents, productivity



# Composition vs Forest Cover



- High forest cover



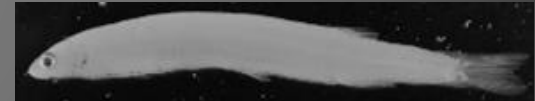
- Little or no forest cover



- High association of non-inanga whitebait entering streams/rivers with high forest cover.



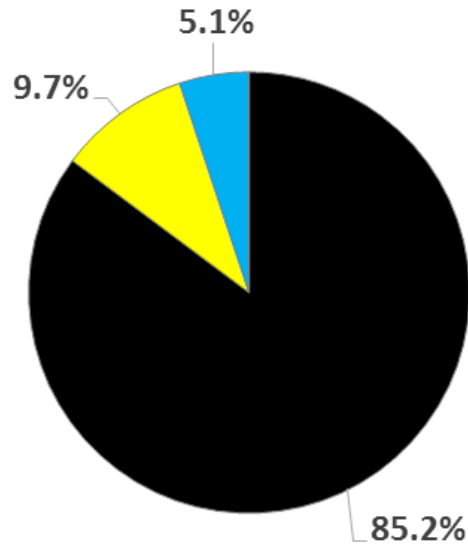
# Composition vs **Adults** in Catchment



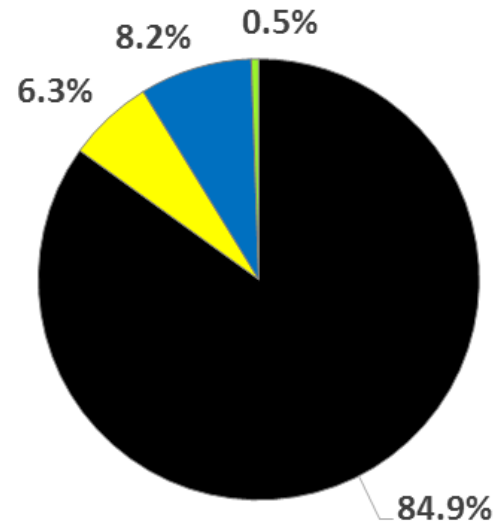
- High association of whitebait entering streams/rivers with adults present in the catchment.

# Has the composition changed in the past 50 years?

Whole of New Zealand 1964



Whole of New Zealand 2015



- Kokopu species grouped together
- Similarities and differences
- New data generated for monthly changes



# What have we learnt?

1. Are there **spatial** and **temporal** differences in composition?

**Yes**

2. Are there temporal differences in **length** and **weight**?

**Yes**

5. Does **forest cover** and **adults** presence within catchments influence composition?

**Yes**

4. Has the whitebait fishery **changed** in the past **50 years**?

**Differences and similarities**





## 5. What are the **implications** for **policy development** and **implementation**?

### Fisheries Management - **Recommendations**

Huge variation between regions:

- Species present
- Timing of the species migration
- Size (length, weight and depth)
- Distinct populations with inter-regional mixing

**Should we be managing the different regions separately?**

**Implementing ideas into policy development?**

# Terrestrial, freshwater & marine ecosystems are interconnected



Diagram from: <http://galleryhip.com/polluted-river-clipart.html>

Overharvesting

Habitat degradation/loss

Water abstraction / Irrigation

Freshwater Issues

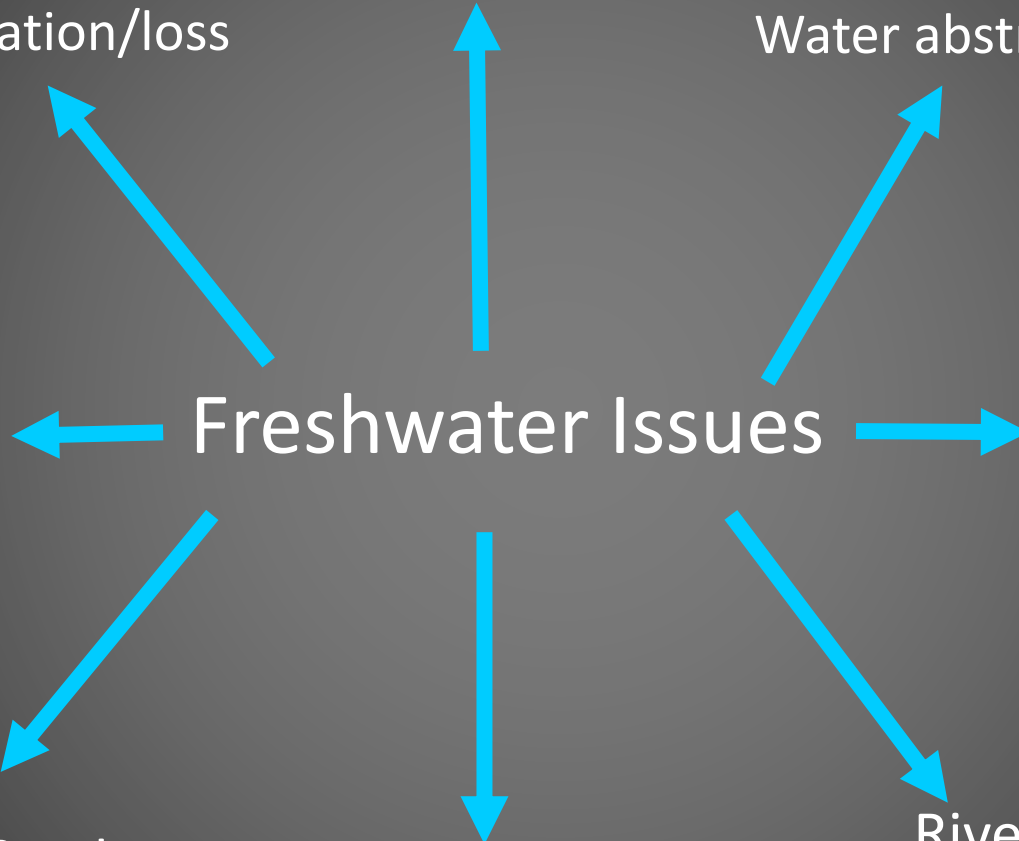
Introduced fish

River Channelisation

Sediment

Nitrogen & other  
pollutants

Fish passage





# Habitat Degradation/Loss

- High association of forest/vegetation cover and non inanga species
- Confirming species present and conservation rating (Dunn et al. 2018 - Conservation status of New Zealand freshwater fish)
- Importance of fish habitat protection
  - \* Significant Ecological/Natural Areas – inanga spawning habitat
- Riparian planting (large sums of money involved)
  - \* Maintenance for 3-4 years of riparian zones, monitoring
  - \* Goals/ Whats Achievable – fencing, riparian setback, wood addition, covenant
    - e.g. 5m/10m riparian setback vs unrealistic 20m
  - \* Hay bales – temporary habitat



# Habitat Degradation/Loss

- Targeted rehabilitation - sources of sediment and nitrogen
- Increasing minimum flows – water in lowland streams (NPS Freshwater Management – guidance)
- High association of whitebait entering streams with adults in catchment
- Fish translocation - opportunities after rehabilitation





# Sediment

- Avoidance of sediment by migrating whitebait
- Timing of earthworks (avoid wet season/consider peak migration times/ needs enforcement)
- Importance of erosion and sediment control plans.
- Planting of key areas (source of sediment/for spawning and adults)
- Fencing off lowland stream (reduce erosion and pugging)
- Protecting headwaters with vegetation cover
- Alternatives to hard engineering for erosion control (fixing problem or creating more problems?)





# Fish Passage

- Whitebait species are diadromous (need to move between freshwater and marine environments)
- Barriers = blocked rivers, weirs, dams, culverts, water abstraction.
- Launch of the NZ fish passage guidelines (Franklin et al. 2018 – NZ fish passage guidelines)
- Options for:
  - \* new culverts and retrofitting old culverts
  - \* baffles, fish ladders, floating ramps, mussel spat ropes



# Legislation

## Fish Passage

Freshwater Fisheries Regulations 1983 - section 42

Conservation Act 1987 – section 48A

‘prohibits culverts and fords to impede to fish passage’

‘...that any dam or diversion structure has a fish facility included & set conditions on their design and performance”

Resource Management Act 1991 – section 13

‘avoiding, damaging destroying, disturbing or removing the habitats of animals in, on, or under the bed of a lake or river’

Implemented in regional and district plan policies and rules (NPS and NES)

## Fish relocation

- Freshwater Fisheries Regulations 1983 – section 70 prohibits killing of indigenous fish

## 5. What are the **implications** for **policy development** and **implementation**?

- Fisheries Management
- Habitat loss and degradation
- Sediment
- Fish passage
- Legislation



# Acknowledgments

<https://sites.google.com/site/whitebaitresearch>

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## Any questions?



Dr. Mike Hickford  
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Prof. David Schiel  
Supervisor

Eimear Egan  
Fellow whitebait student

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Research Assistant

Jan McKenzie  
Lab Technician