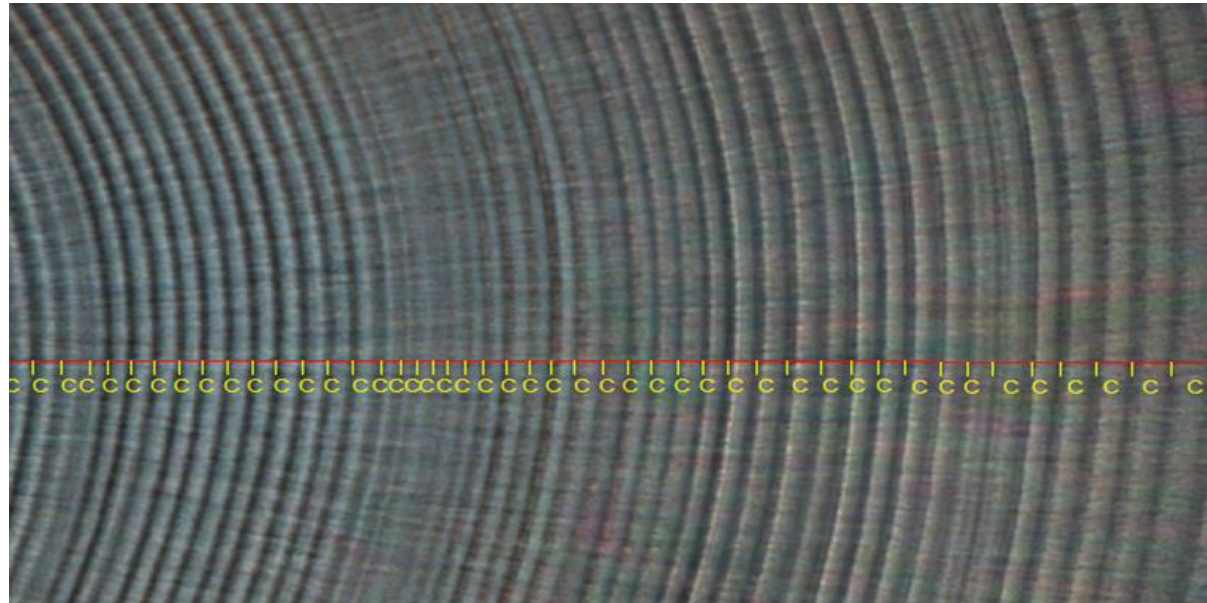


Using otolith microstructure to reconstruct marine development in the New Zealand whitebait *Galaxias maculatus*



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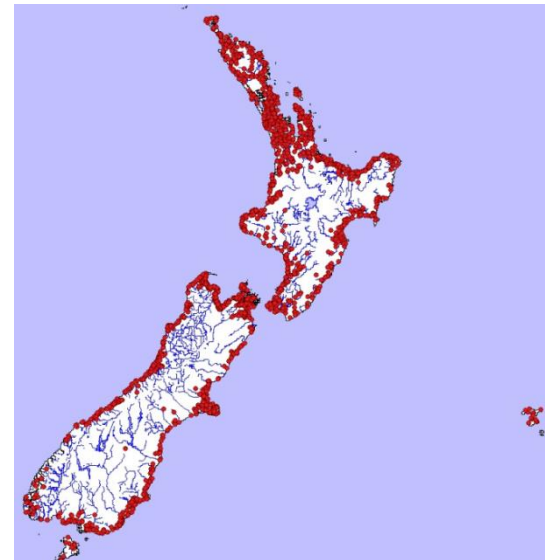
David Schiel



Galaxias maculatus (Inanga) ecology



- One of five migratory galaxiids
- Lowland coastal rivers
- Widespread distribution
 - Environmental & biophysical gradients



Gregarious spawning



Amphidromy



The Fishery

- Cultural
- Recreational
- Commercial



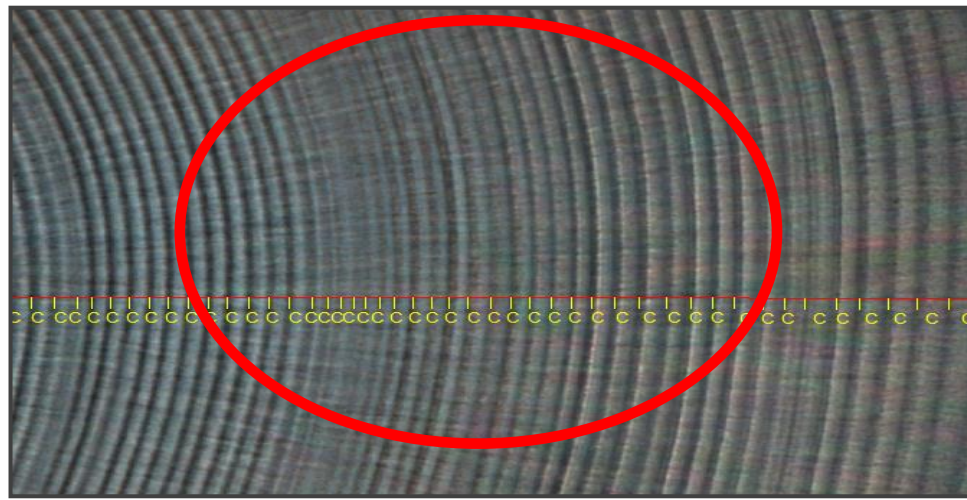
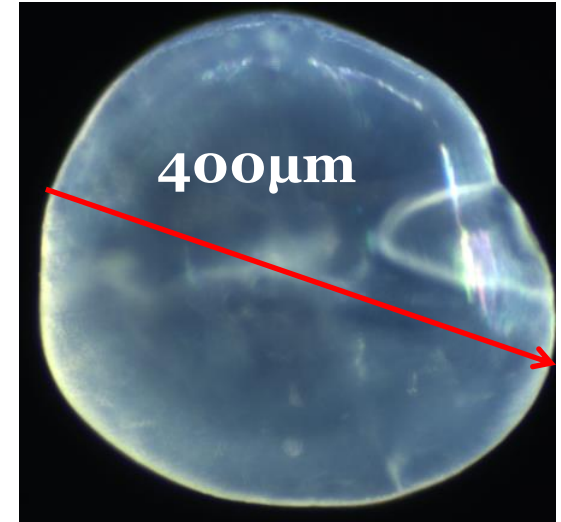
The challenges

- Complicated life cycle
 - Population dynamics not understood
 - Conventional techniques are inappropriate (tagging, genetic studies)
 - Impedes conservation and management
- “The whitebait fishery has always been a hit and miss *ad-hoc* affair” McDowall 1991
 - Atypical fishery
 - No quotas, licences
 - Management or mismanagement?
- Anecdotal evidence of population decline
 - Data poor fishery



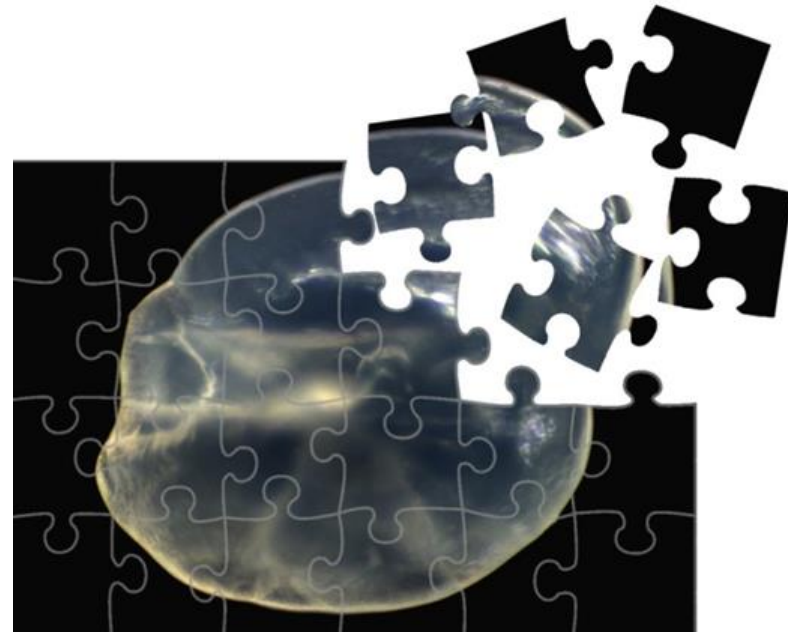
Otoliths, biological recorders

- Ear stones
- Biological diary
 - Daily growth rate (μmd^{-1})
 - Age
 - Microchemistry (fish movement)
 - Diet ($\delta^{13}\text{C}$)
 - Thermal history ($\delta^{18}\text{O}$)
- Daily resolution

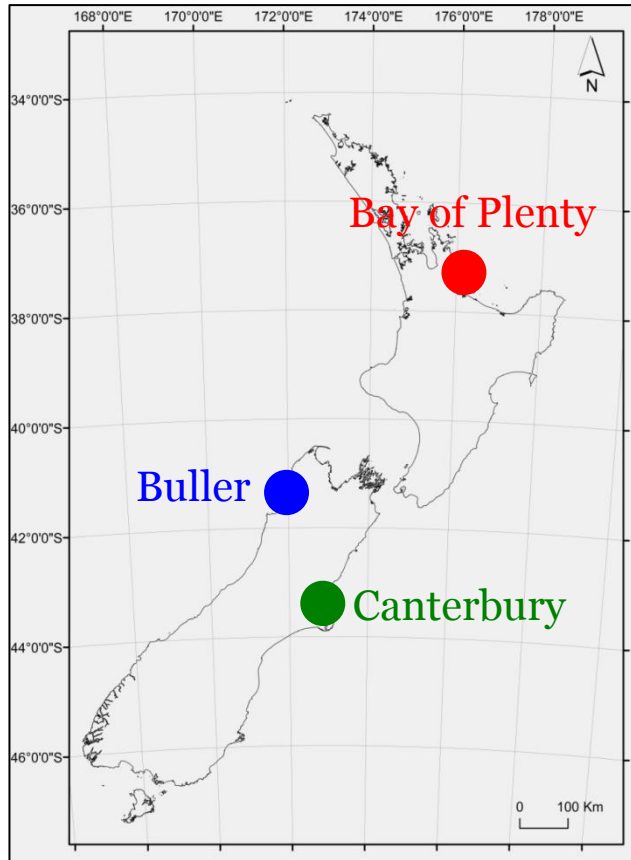


Key questions

1. Are the larval traits of *G.maculatus* populations homogenous throughout New Zealand?
2. Can the marine development stage of *G.maculatus* be reconstructed using otoliths?

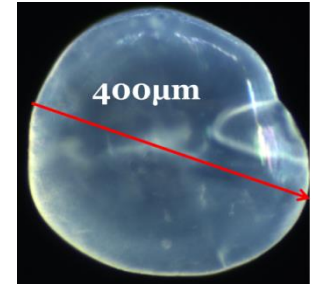


Methods

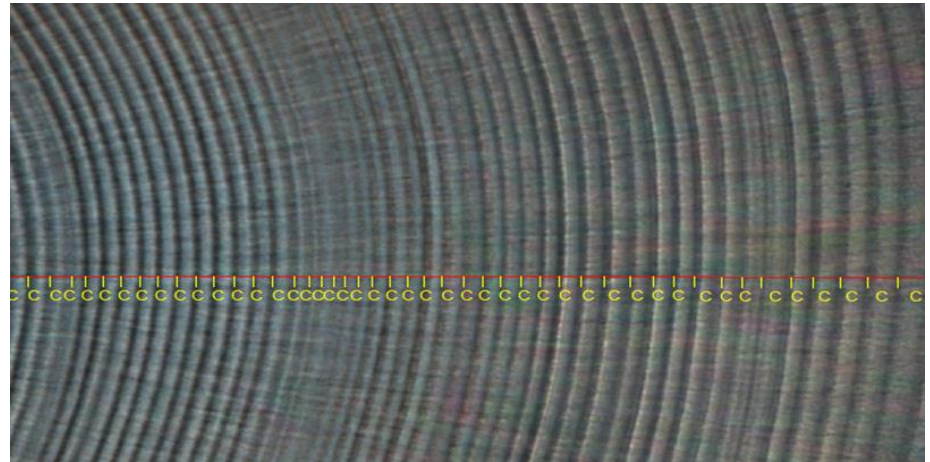


- 3 regions, 3 sites in each
- Fortnightly sampling (Sept to Nov)

- Otoliths extracted, cleaned and polished



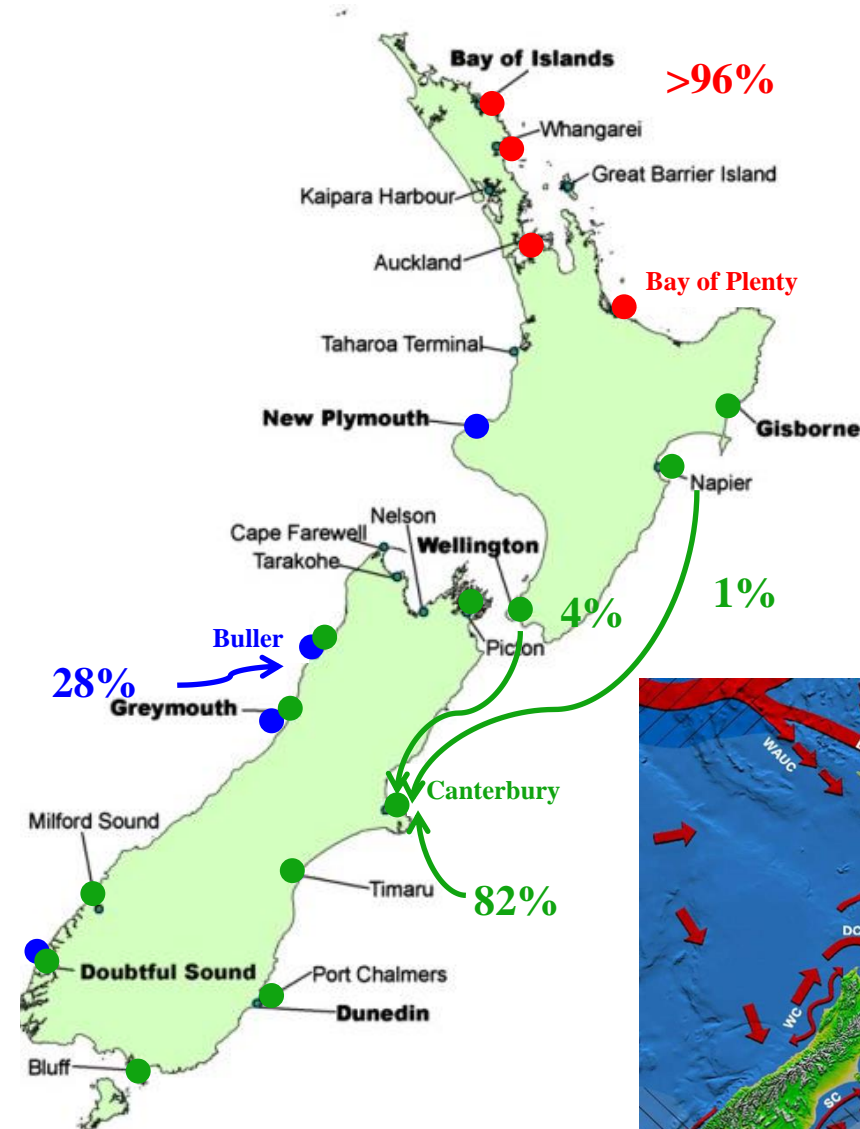
- Photographed 63x, oil immersion, automatic measurements



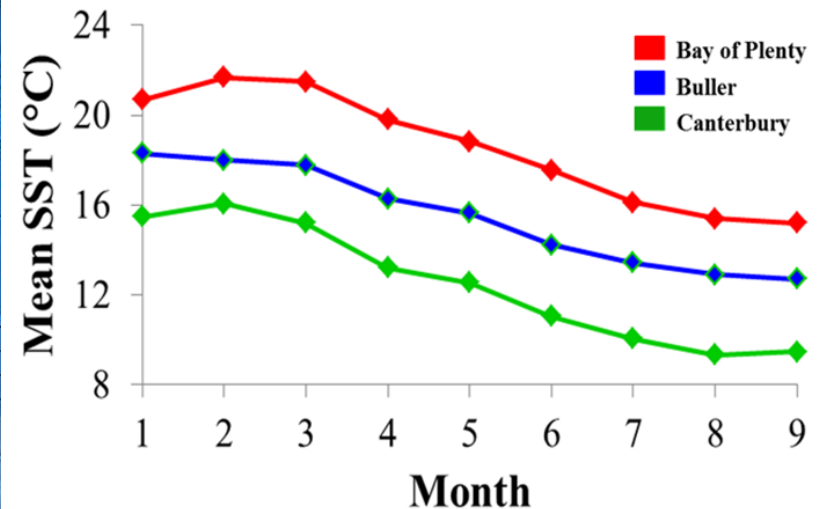
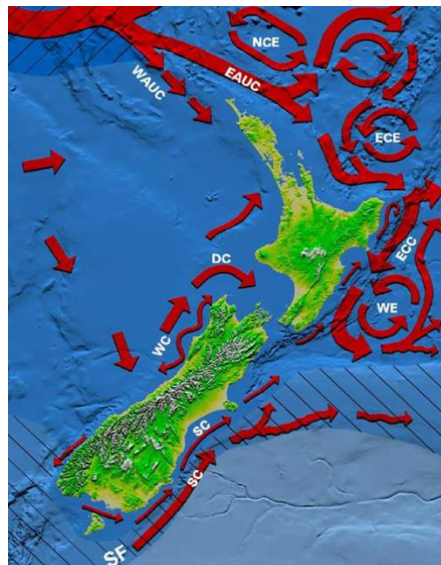
- Counts - pelagic larval duration
- Increment width - growth per day

Sites

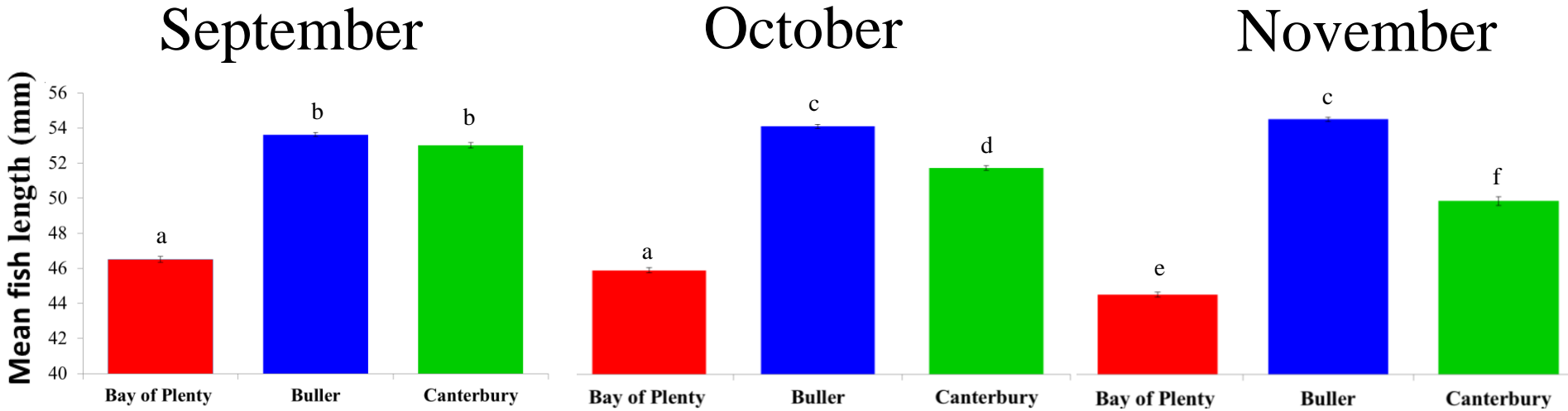
- Oceanographic boundaries
 - Dispersal potential limited
 - Regional retention?
- Environmental history
 - Temperature and food
 - Growth rates
 - Metabolism
 - Stage duration



Chiswell *et al.*, 2011

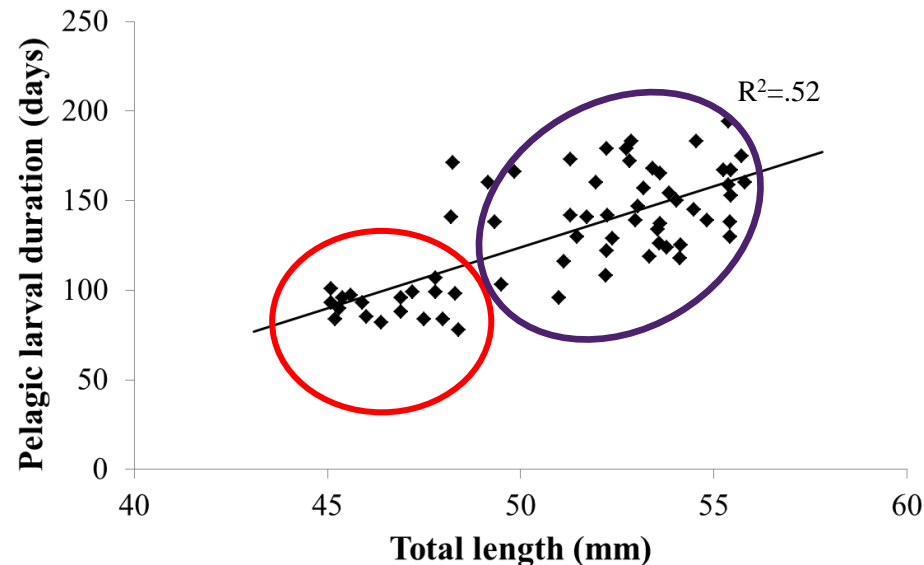
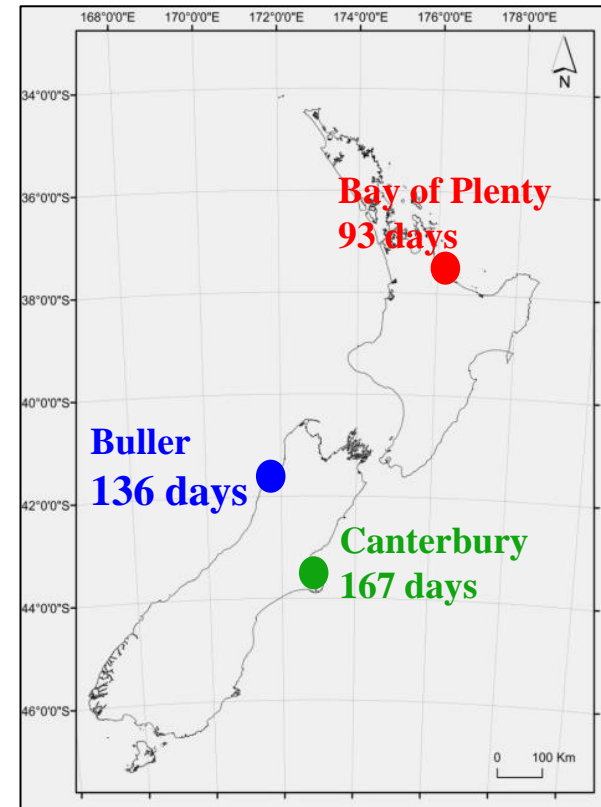
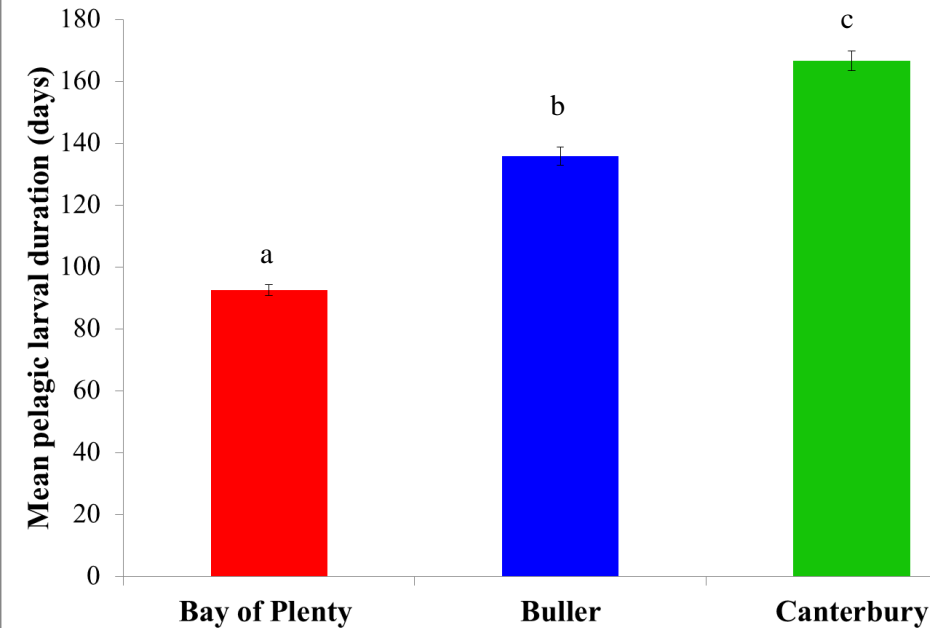


Size at recruitment



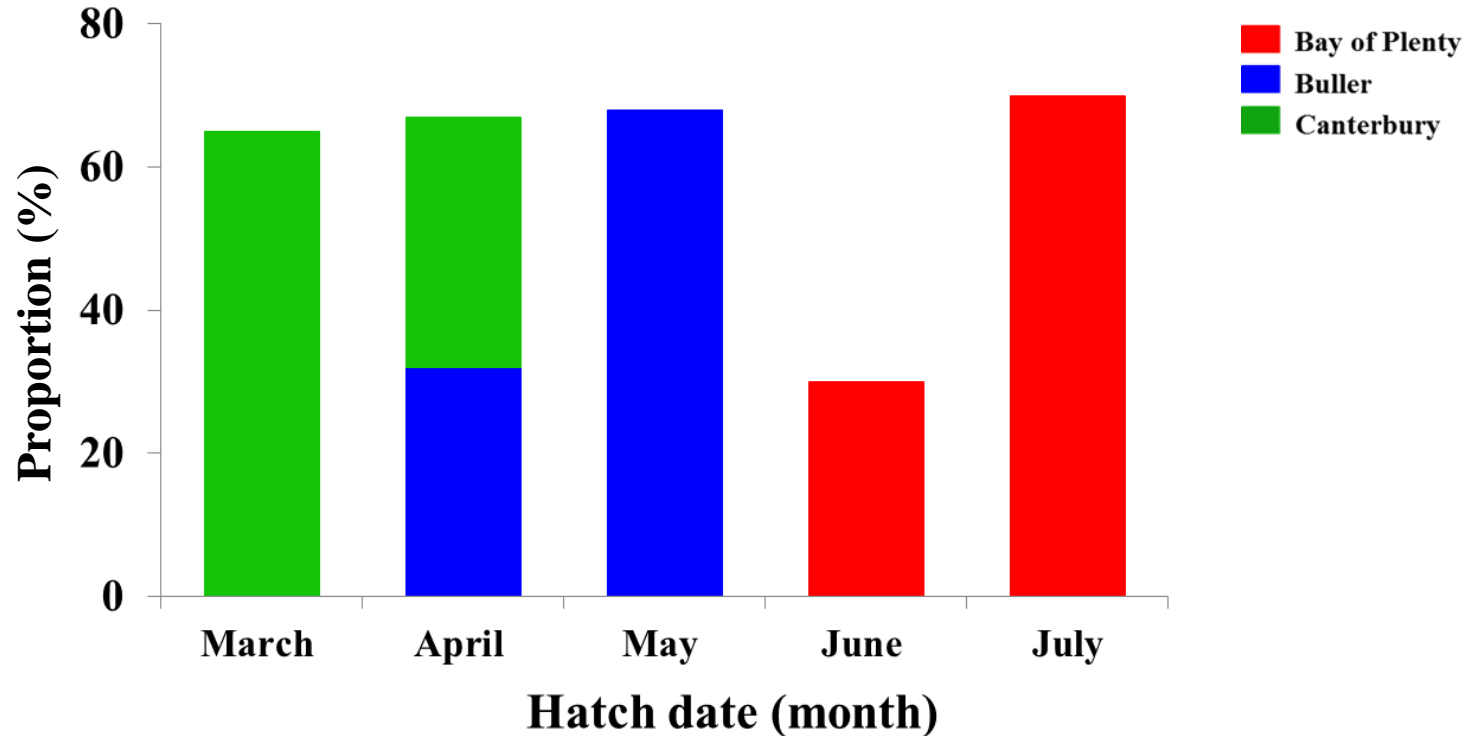
- Spatial →
 - **Bay of Plenty** fish average 46 mm
 - **Buller** & **Canterbury** similar (53-54 mm)
 - Spatial pattern is consistent
- Temporal →
 - **Bay of Plenty** & **Canterbury** smaller
 - Little difference in **Buller** cohorts

Pelagic larval duration



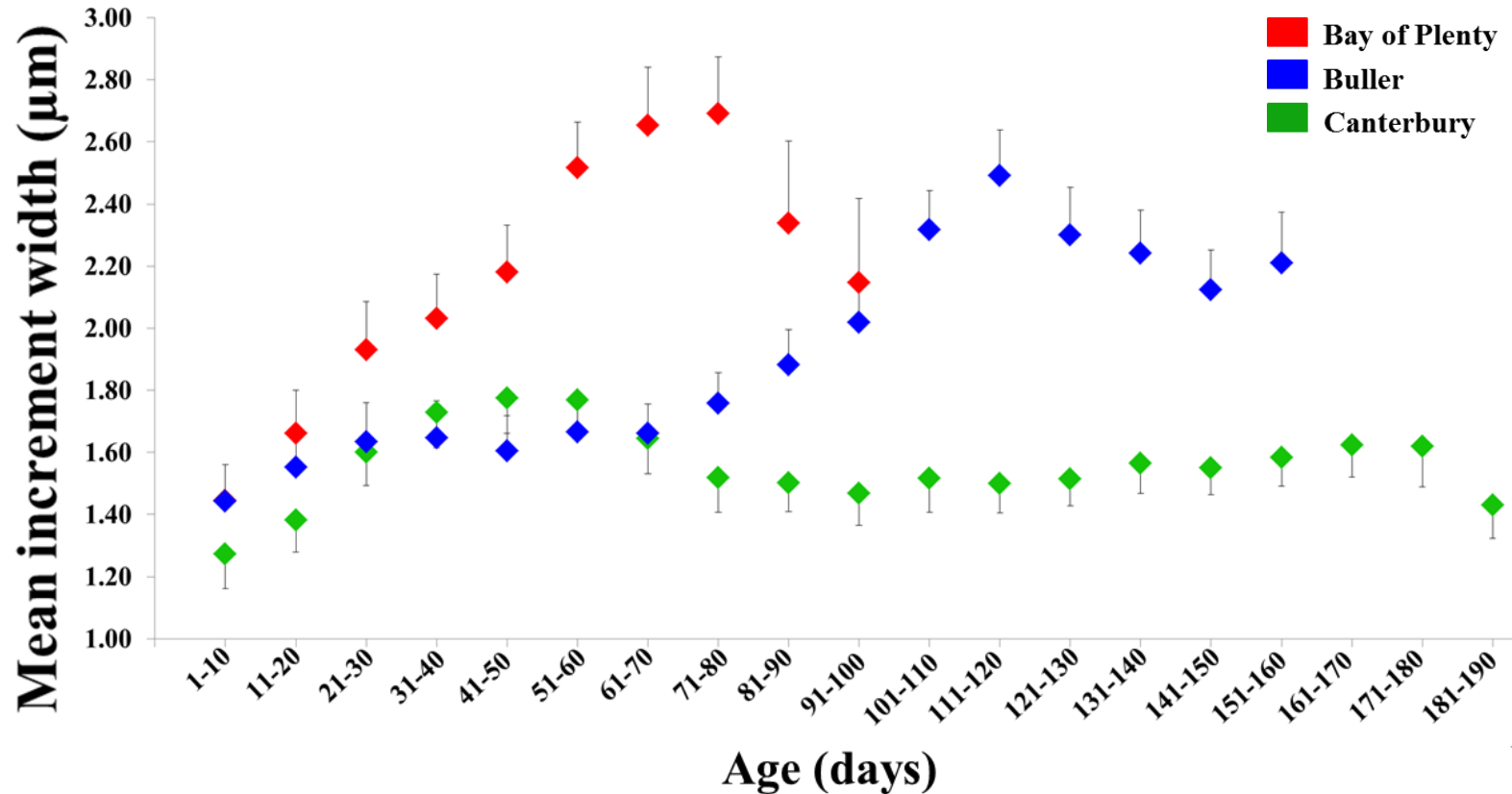
- Latitudinal
- Generally longer PLD = larger size at recruitment
 - **BOP** stronger relationship

Hatch dates are different



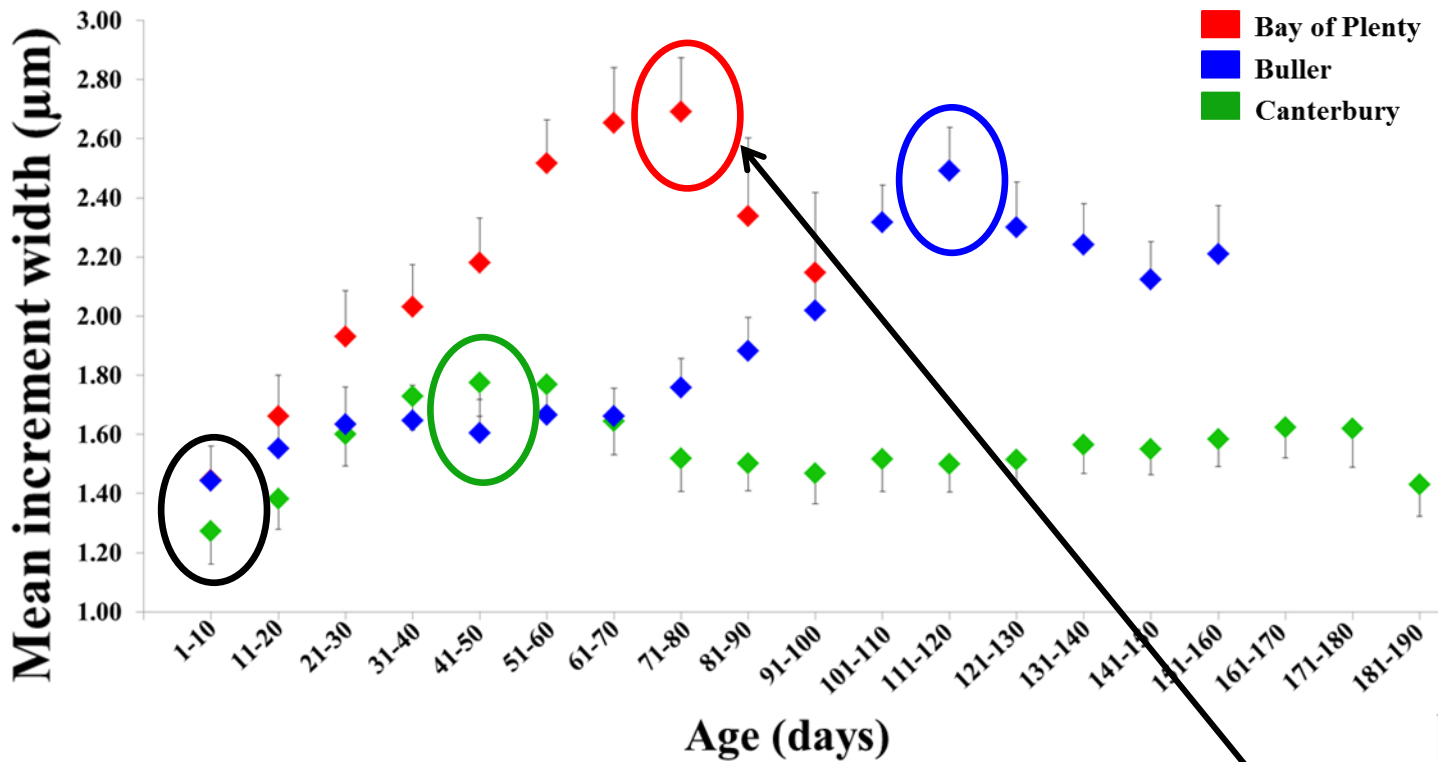
- Latitudinal variation in hatch dates
- Results consistent with gonad histological studies for **Buller** and **Canterbury** (Hill *et al.* 2013)

Population-specific growth differs



- Spatial variation
 - **Bay of Plenty** highest growth rates (max 2.7 μm)
 - **Buller** and **Canterbury** similar growth rates up to 71 days
 - **Canterbury** lowest growth rates

Population-specific growth differs



- Temporal variation
- Offset in timing of maximum growth
 - **Bay of Plenty** = 71-80 days
 - **Buller** = 111-120 days
 - **Canterbury** = 41-50 days

Metamorphosis?
Habitat shift?

Summary

- Larval characteristics are not homogenous
- Spatial and temporal variation
 1. Growth rates
 2. Size at recruitment
 3. Hatch dates
 4. Pelagic larval duration
- What does this mean?
 - Genetic differences?
 - Environmental history different?

Future research

- Otolith microstructure has limitations
 - Don't know dispersal history
 - But populations are different
1. Otolith morphometrics as a complimentary tool to discriminate populations (see poster)
 2. Reconstruct environmental history using $\delta^{18}\text{O}$ as a proxy for thermal history and $\delta^{13}\text{C}$ food sources
 - Are environmental variables responsible for the differences in growth rates or are there some other intrinsic factors?

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