Swimming performance of juvenile temperate fish in response to climate change

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Swimming performance

- Determines the organism survival and is related to vital activities.

Prolonged swimming performance (Ucrit)

- An approach to assess the prolonged swimming performance.
- has been first invented by (Brett, 1964).
- This is the speed at which maximum sustainable oxygen uptake occurs (Gregory and Wood, 1999).
- Species specific (Hammer, 1995; Nelson and Chabot, 2011).
- Has believed to be influenced by salinity and temperature (Deslauriers and Kieffer, 2012; Yetsko and Sancho, 2015).
- Provides potential information for better understanding the organism biology and can be applied to aquaculture management systems.
• Sustained aerobic swimming performance (Ucrit) (Temperature and salinity effects).

• Environmental variability and locomotion.

• Species performance and its tolerance limit.
King George whiting

- The most commercial and recreational fish of Southern Australia.
- Longevity: 22 years
- Maximum size: 590mm (total length).
- Maturity: 3-4 years, 300-350mm (total length).

Fish collection
(Port Vincent on the east coast of York Peninsula, South Australia (34°46′0″S, 137°51′0″E))

Fish maintenance
(Aquarium room, The University of Adelaide)
Experimental Design

- **Holding tank**
- **Replicate tanks**
  - **16°C**: 30‰, 40‰
  - **19°C**: 30‰, 40‰
  - **22°C**: 30‰, 40‰
  - **25°C**: 30‰, 40‰
Swimming performance

- Fish were left for a minimum of 3 weeks in holding tanks to acclimatize to the new condition.

- Temperature and salinity, as well as ammonia and nitrite levels in seawater were monitored on a daily basis using an electronic water quality unit (YSI Sonde, 556 MPS) and ammonia and nitrite test kits.

- Half of the seawater in tanks was exchanged every other day, ensuring that the ammonia level in the water never exceeded 0.25ppm.
Swim chamber respirometer (170ml), Loligo Systems, Copenhagen, Denmark.

- The velocity of the water was calibrated using a digital flow tracking system before starting the swim test.

http://www.loligosystems.com/
Fish were fastened for 48h before starting the test

Fish were rested for a minimum of 10h in the chamber to rest.

Swim test

- Increasing water velocity by 0.3 BLs-1 every 60 minutes until fatigue.
- Ucrit was interpolated from the final steps of swimming (Brett, 1964)
$U_{\text{crit}} = U + \left( \frac{t}{t_i} \times U_i \right)$

$U = \text{Last speed expressed in BLs}^{-1}$

$U_i = \text{The velocity increment expressed in cm/s}^{-1}$

$t = \text{The time fish swum in the final velocity increment}$

$t_i = \text{The set time interval for each velocity increment (60 min)}$

**Statistical analysis**

General linear mixed effect models (GLMM, lme function in R) (Pinheiro and Bates, 2000)
Mixed modelling approach

- Separate GLMMs
  - Stepwise forward procedure with the optimal model at each step selected based on lowest Akaike information criterion corrected for small sample size (AICc) (Burnham and Anderson, 2002)

- Random term: replicate tanks
  Fixed terms: temperature, salinity and their interaction

- Best supported model was (salinity), AICc: -8.26
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![Graph](image-url)
DONE WITH MY PRESENTATION

NOW I HAVE TO ANSWER QUESTIONS