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Will they stay or will they go? Movement and recruitment dynamics of an iconic Australian freshwater fish in a cold-water impacted River

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Will they stay or will they go?
Movement and recruitment dynamics of an iconic Australian freshwater fish in a cold-water impacted River

Zeb Tonkin, John Koehn, Jarod Lyon, Graeme Hackett, Justin O'Mahony, Charles Todd and Sarah Commens
Outline

• Threatening processes for native fish in MDB
• Coldwater pollution and study system
• The status of Murray Cod in the River and hypotheses explaining its dynamics
  – Movement
  – Spawning and recruitment
  – Stocking
• Data relating to each
• Wrap up
Threatening processes for native fish

- Mining
- Introduced species
- Water quality
- Disease
- Overfishing/illegal fishing
- Habitat degradation
  - Desnagging
  - Channelisation
  - Riparian loss
- Barriers
- River regulation
- Coldwater pollution
Dartmouth Dam

- Completed in 1979
  - Augment irrigation supply to the Murray River
  - Electricity generation
- 180m high
- 3,856 GL
- Water releases are made from two outlets positioned at depths of 62 m and 121 m below fully supply level…
Dartmouth Dam – downstream impacts

Downstream Mitta Mitta River…
- Cold spring and summer water temperatures… Up to 12 °C below natural levels!
- Altered flow regime…
  - Increased magnitude and variation of summer flows
Impacts on d/s fish community

• Massive impact on native fish populations in lower Mitta Mitta River (~100 km)
  • Construction
  • Desnagging and channelisation
  • Flow regulation and coldwater pollution

• Large-bodied native fish reported as locally extinct or in unsustainable numbers in early 1990’s (Koehn et al.)

• River determined as unsuitable to support sustainable populations… even for stocking (Todd et al. 2005)
Current fish populations...

Next two decades little consideration of river health or native fish by management
In more recent times...

• **Murray cod** persisted in lower reaches in low numbers...

• Last decade catches have increased dramatically...
  - Stocking underway since 2006?
  - Low flow years, esp. end of drought enhancing key population processes?
Recognised values

- Increased awareness of the values in the River
  - Made managers sit up and take notice!
- Now a greater focus on looking after the health of the river
  - Water operations (GMW and MDBA)
  - Other catchment management initiatives (bank, riparian and instream habitat works; DELWP & CMA)
- Includes Learning by doing
  - Flow pulsing trials and monitoring (using biofilm as an indicator)
  - Murray cod population dynamics... 2013 – 2018 (this project)
Project objective

Five year study 2013 – 2018 aim of:

Increasing knowledge of the Murray cod population in the lower Mitta Mitta River
- Why have they persisted and/or returned?
- Use information inform river operations
Murray cod

- Up to 1.5m; 50 kg;
- long-lived (maximum 49 years), maturation ~5 years
- Undertake largely upstream movements (up to 120 km) in late winter and early spring associated with spawning
- Lay adhesive eggs on hard substrate in spring (October & November) at temperatures greater than 15°C
- Survival of fertilized eggs reduce by 50% if water temperatures fall below 14.8°C (with 100% mortality occurring at 13°C)
- Larvae hatch after approximately 5–13 days then undergo downstream drift to settle in the main river channel
Project aims:

Test how altered flows and cold water releases influence key population processes

1. Movement
2. Recruitment
3. Survival and growth (inc. Stocked fish)

Look at each under different release years
- High Spring & Summer releases / low temperature
- Low Spring & Summer releases / High temperatures
Hydrology
1. Movement

Hypothesis:
Periods of unseasonal coldwater releases will:

- Increase downstream movements, including emigration out of the reach;

- Seasonal adult spawning movements will decrease and/or occur outside of the traditional winter_spring migratory period
1. Movement

- 25 adult fish (55 - 1100 cm TL)
- 69-kHz acoustic tags (Vemco)
- Tagged in May 2013
- 10 listening stations along 50 km reach
Movement Results

2013 – 2016:

• Strong site fidelity with no evidence of emigration during coldwater periods

• Several large movements, up to 50 km both upstream and downstream

• Reduced likelihood of undertaking large movements (40% of fish shifted range vs. 85% Koehn et al. 2009)

• Sig. effect of day-of-year
  • Most movement outside the “normal” window

• Last two years?
2. Population structure and recruitment

- High Spring & Summer releases / low temperature
  - No recruitment / low stocking survival

- Low Spring & Summer releases / High temperatures
  - Natural Recruitment / increased stocking survival
2. Population structure and recruitment

- Electrofishing survey data across lower 50 km of river
  - 2013, 2015, 2017, 2018 standardised surveys (33 sites)
  - Lengths; weights; External tagging
  - Otolith collections (growth and ID)
Population structure

N=24

N=78

N=139

N=121

Length (mm)
Year class strength

- Warm spring conditions for spawning weren’t as good as first thought… What about 2015/16?
  - Natural Spawning & Recruitment?
  - Survival / retention of stocked fish?
  - Summer flows post-stocking?
Natal origin

- Compared microchemistry signatures of otoliths (87Sr/86Sr) between hatchery vs wild caught juvenile fish
- Most (all) juveniles in recent years stocked
  - Summer flows important for juvenile survival
  - Implications for hatchery and wild populations
  - Analysis underway…
Growth

- Movement highlights fish stayed in system during cold periods
- Mark-recapture data
  - Large fish considerable somatic growth
- Age vs length distribution
  - Somatic growth equivalent (or better) with nearby populations
Wrap up

- Murray cod have been heavily impacted by river regulation and cold-water releases
  - Alterations to migration
  - Natural recruitment… still some Questions
- Murray cod permanent fixture in the lower Mitta Mitta River
- Still get native fish / fisheries outcomes in cold-water polluted reaches… need help via.
  - Augmentation from stocking (esp. during years of low water transfers)
  - Minimise flow delivery (coldwater impacts) during critical early summer period…
  - Instream habitat restoration underway
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